DOCUMENT RESUME

ED 263 059 SP 026 653

AUTHOR Schenkat, Randolph J.; And Others
TITLE It Stands to Reason. The Rationale and Implementation of a Development-Based, Liberal Arts Oriented, Teacher-Education Program.
INSTITUTION College of St. Teresa, Winona, Minn.
SPONS AGENCY Office of Vocational and Adult Education (ED). Washington, DC. Div. of National Vocational Programs.
PUB DATE 85
GRANT G00-810-2088
NOTE 122p.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS *Educational Change; Higher Education; *Preservice Teacher Education; *Program Development; *Student Centered Curriculum; Student Development; *Teacher Education Programs
IDENTIFIERS College of Saint Teresa MN

ABSTRACT

The rationale and implementation of a development-based, liberal arts oriented teacher education program established by the College of St. Teresa (CST) in Winona, Minnesota are described. The program began changing in the mid-1970's, and has gradually responded to several issues such as the Dean's Grant Program and the National Commission on Excellence in Education. The first chapter of this report details needs to focus on student development. A unified science program is discussed in Chapter 2, and Chapter 3 describes the Dean'S Grant Program for CST education students. The fourth chapter describes changes occurring as a result of CST's "Design for Choicemakers" program. Organizational factors that support the program changes are considered in the fifth chapter. Source materials which were prepared for the different projects at CST are presented in appendices. (CB)

The Rationale and Implementation of a Development-Based, Liberal Arts Oriented, Teacher-Education Program

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This publication is produced to fulfill the requirements of Grant No. G00-810-2088 from the U.S. Department of Education. It is distributed to a limited audience for purposes of dissemination.

1985

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CONTENTS

PUBLISHED BY

Counterpoint

COMMUNICATIONS COMPANY

PRODUCT DISTRIBUTION CENTER
9618 Percussion Way
Vienna, Virginia 22180

EDITORIAL OFFICE
2150 Brisbane Avenue
Reno, Nevada 89503

1985

FOREWORD

Public education in the United States always has been in an anomalous position. Since the first dame's school was organized in Boston in the late seventeenth century, schools have been expected to provide more, and more different kinds of services for more, and more diverse children yet the educators who provide these services have tended to be held in low esteem. We look to schools to perpetuate traditional beliefs and culture yet we demand that schools be the agents of change (Kluckhohn, 1949), for example, in Americanizing immigrants and leading society in the integration of races and minority groups. Schools have become markedly better over the centuries yet they always have been found wanting. In recent years the criticisms have become more pervasive and sharper, not so much because schools have become worse per se but, it seems more likely, because our economy and society are changing so much so fast.

In 1981, **Newsweek** described schools in the United States as having been chronically "in crisis, whether they were struggling to teach the three R's to pioneers or American ways to immigrant children." The current problem was reported to stem from "a very real increase in the need for education" to meet the challenges of the future. This criticism was summarized by Graham Down of the Council for Basic Education when he said, "What passed for competency in 1960 wouldn't pass for it in 1980 and cannot hope to pass for it in the year 2000" (**Newsweek**, 1981, p. 63).

In 1983, the National Commission on Excellence in Education presented an even grimmer picture. The educational foundation of our society, according to the report, has been "eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people." The report made the startling observation that "if an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war" (p. 5). Specific criticisms were directed to the failure of American students to achieve as well as their foreign peers, the high rate of functional illiteracy in the country, the failure of over half the population of gifted students to achieve up to their potentials, and the apparent decline in students' ability to solve problems that require higher order thinking skills (see pp. 8-9).

The purpose of the Commission was to identify, not to seek the causes of, the problems impeding the delivery of "excellent" education to the nation's high school and college students. "Excellence" was defined in the report in terms of individuals, schools, and society.

> At the level of the **individual learner**, it means performing on the boundary of individual ability in ways that test and push back personal limits, in school and in the workplace. Excellence characterizes a **school or college** that sets high expectations and goals for all learners, then tries in every way possible to help students reach them. Excellence characterizes a **society** that has adopted these policies, for it will then be prepared through the education and skill of its people to respond to the challenges of a rapidly changing world. Our Nation's people and its schools and colleges must be committed to achieving excellence in all these senses. (pp. 12-13)

Unfortunately, the goals given in the definitions are highly abstract. Not surprisingly, then, the subsequent suggestions for the achievement of the goals are merely more of what the schools are already doing. In general, the report urges increased public support for education, revision of curricula, the adoption by schools and colleges of "more vigorous and measurable standards" (p. 27), more effective use of time in classrooms, and increased respect and rewards for persons engaged in education. Nowhere does the report suggest that the major problem may be schools' emphasis on teaching rather than learning. Furthermore, the report illustrates the fallacy of calling for excellence in the abstract rather than the concrete. More than 15 years ago Sanford (1967) warned against this practice.

> When excellence in the abstract is urged by persons in positions of authority or leadership, it sounds like an injunction to do more thoroughly what is already being done . . . .(p. 13)

We contend that if schools and colleges are to achieve excellence in the education of children and young adults, then radical changes must be made in the focus of instruction. Essentially, children must be taught to learn to think. We recognize the importance of knowledge, of course; it provides the substance for thinking. But imparting knowledge alone leads merely to exercises in memory and recall. From the very beginning of schooling children must be encouraged to think critically about what they are taught - to analyze, synthesize, and evaluate.

Sad to say, although in elementary, junior high, and high schools many teachers list as part of the curricula they follow critical thinking, learning how to learn, developing reasoning skills, and acquiring habits of inquiry, few teach to these cognitive skills. In his detailed study of what actually goes on in the schools, Goodlad (1984) found that teachers' performances in classrooms are far removed from what they say they do. At the same time, all the failings of junior high and high schools characterize most college classrooms (Goodlad, 1983). Yet the faculty members of institutions of higher education seem to turn a blind eye to their own failings and to point accusingly at the secondary schools for the failures of college students and even to blame the innate abilities of students.

At the college level, unfortunately, many faculty members seem to hold the attitude that their responsibilities are limited to teaching the content of courses and to grading students on how well they recall the content on examinations. Yet, traditionally, the role of college professors includes the enhancement of those personal traits and abilities that are valued in a democratic society. Knapp (1962, p. 291) reported that by custom the three focal functions of faculty members at higher institutions are "the **research function**, the **informational function**, and the **character-developing** [student development] **function**, of which all others are aspects or combinations." Over time, the character-building function of faculty members declined and the research and informational functions parted company (Katz, 1962). Thus research tended to become the general province of universities while the dispensing of information was given priority at two- and four-year colleges. Nevertheless, college faculty members are not trained to be educators. "College teachers," consequently, "are highly professionalized in regard to the subject matter they teach. They are not at all professionalized as educators" (Katz, 1962, p. 367). This implicit downgrading of pedagogy at institutions of higher education tends also to imply that faculty members have no responsibility for the development of students as learners or citizens. The preponderance of educators even seem not to understand what the development of students has to do with education.

College instructors who expect all students to respond to lectures on or discussions of complex notions with mature judgements are generally disappointed. Some compensate by expending as little energy on teaching as possible, others, by looking for those one or two students in a class who seem to display superior intelligence and teaching to them to the neglect of the other students. The latter, made to feel that they are intellectually inadequate, concentrate on learning to parrot the new ideas without examining or trying to understand them.

Sanford (1967) pointed out the dangers of not using critical thinking to look at new ideas:

> When some thoughts cannot be allowed, all thinking tends to deteriorate in quality; myths and stereotypes flourish, and wishful or fearful ruminations take the place of realistic attacks on problems. (p. 6)

The fear of analyzing ideas, whether old or new because of the discomfort it engenders confines intellectual growth to narrow and restricting channels. The mind is closed to all new notions. Yet, progress, any kind of progress, whether in community affairs, interpersonal relations, creative endeavors, or technological development, depends upon openness to new ideas, to the readiness to examine them critically and to relate them to what one already knows, and to fearlessness in rejecting what is not useful.

Our colleges need instructors who are able to help students to achieve this goal. It is the

kind of education that is needed for the future. Goodlad (1984) concluded, after examining relevant reports in the literature, that "the most serious limitations of our schools may well be in areas where little public concern has been voiced and about which we have a false confidence" (p. 15). Student development is one such area. Schools have concentrated so hard on filling students' minds with increasing amounts of information they take little time for concern with how students use the knowledge.

We pay lip service to the idea that educational institutions must prepare students for an uncertain future that will demand new kinds of skills and training. Our schools and colleges, however, continue to prepare students for the specific roles that are visible today. What our institutions must do is to provide environments in which students' full potentials — intellectual, social, and psychological — can be developed. This kind of preparation would give students the fundamental tools to adapt to unknown and unpredictable situations. Thus, furthering student development as well as transmitting new skills and areas of knowledge should become the objective of all educational institutions.

The first systematic, theory-based studies of colleges in recent years were undertaken by academicians during the 1950s. One of the leading figures in this research was Dr. Nevitt Sanford, a psychologist who, earlier, had participated in studies of why people persist in holding destructive prejudices. His findings indicated that college can make a difference in the intellectual, psychological, social, and humanistic growth of students. As a result of Sanford, a psychologist who, earlier, had participated in studies of why people persist in initial impetus (Parker, 1978). The College of St. Teresa (CST) began a related program during the early 1970s. It concurs with the definition of excellence which the National Commission on Excellence in Education laid down for schools.

CST is a four-year residential institution for women funded by the Order of Franciscans in 1907. It is situated in Winona, Minnesota, a nineteenth century port on the Mississippi River with a current population of about 25,000; St. Paul, the capitol of the state, is some 120 miles to the north. The college enrolls 500 students. It offers baccalaureates in liberal arts, some professional programs, and certification in education from preschool to secondary teaching, mental retardation, and speech and language. About 95 students are enrolled in the education programs.

Like many small colleges, and especially those with religious ties, CST always has given strong emphasis to character development but, until the mid-1970s, along conventional lines: The academic division concentrated on intellectual development and, in a department or two, on the development of values; the student affairs division took responsibility for discipline and for students' social, personal, and career development; and spiritual development was the responsibility of the college chaplain. How students learned and how they integrated what they learned was regarded as personal; no one considered it necessary or even desirable to intervene. In fact, the responsibility for success or failure was held to rest solely with each student, an attitude that seemed to prevail generally throughout academia, as if students were locked in by innate factors to specific levels of achievement.

The first academic change at CST was brought about somewhat fortuitously by the efforts of three science educators during the conduct of a National Science Foundation grant that, ultimately, totaled about $197,000 and extended from 1971-1975. The funds supported the development of an integrated science curriculum for preservice elementary teachers in which they learned to encourage the growth of critical thinking skills in elementary school students by enhancing their own critical thinking skills.

Then, in 1973, the Franciscans at Rochester, Minnesota, the mother house of CST, issued a Sponsorship Statement that led to what has been characterized as "a totally new understanding of the concepts of developmental education and student-centered education." The undertaking, supported by a grant from the Northwest Area Foundation in 1978, resulted in the publication (July 1982) by CST of its "Design for Choicemakers," a commitment by faculty and staff members "to the integration of liberal learning and professional education within the tradition of the Judaeo-Christian Faith" and to helping each student, "to achieve the goals of a liberally educated

person" (College of Saint Teresa, 1982). The guidelines are directed to (a) critical thinking, (b) aesthetic/cultural development, (c) communication, (d) breadth of perspective, (e) autonomy, (f) social relationships, and (g) life goals. It is a comprehensive, exemplary program of student development that should be of interest to the faculties and personnel of all small colleges in particular and to all institutions of higher education in general.

Two years after Public Law 94-142 (The Education for All Handicapped Children Act of 1975) became effective, CST was awarded what turned out to be a 6-year grant by the Office of Special Education, U.S. Department of Education, through the Dean's Grant Program. The initial goal of the project was the infusion of mainstreaming content into the curriculum but it evolved into developing critical thinking skills in prospective teachers to enable them to teach the diverse students populating mainstream classrooms and to resolve the students' learning problems.

What has been happening at CST since the early 1970s, in sum, is the development of a process of learning by which students are prepared to meet unknown challenges. Sanford (1967) likened this kind of education — education for the world of tomorrow — to preparing successful volunteers for the Peace Corps.

> . . . each had to have some particular competency, but once a volunteer got on the job it was not his specialty that mattered; **it was his readiness to do things that nobody had dreamed of, his resourcefulness in a novel situation.** (p. 11; emphasis added)

Student development, in short, focuses teaching on such qualities as helping students to achieve "a stable personal identity, social responsibility, [and] the ability to learn to improvise" (Sanford, 1967, p.11), qualities that encourage the enhancement of creativity as well as the ability to meet new challenges.

The exciting changes occurring at CST are described and discussed in the following chapters. First we take a more detailed look at student development (Chapter 1), then we examine the unified science program (Chapter 2) and the enriched Dean's Grant project for education students (Chapter 3). Chapter 4 describes the changes occurring on the CST campus as a result of the "Design for Choicemakers" program. In Chapter 5 we consider organizational factors that support change as well as those factors that supported the initiation of student development on the CST campus. Some of the source materials which were prepared for the different projects at CST are given in the appendices.

ACKNOWLEDGEMENTS

The Dean's Grant effort at the College of Saint Teresa had much good fortune during its six years. The project's officers and Dean's Grant advocates in the Division of Personnel Preparation were incredibly supportive of a venture that took a different path.

The National Support Systems Project carried out its role of support, encouragement, linking, and disseminating in its conduct with the College of Saint Teresa project. It early went to bat for the project fiscally and encouraged and shared the ideas coming out of the project.

As the project began to center on the work of William Perry, individuals across the country willingly shared their expertise, materials, etc., in applying student development ideas to Teacher Education. In particular we acknowledge Larry Copes, Pat King, Lee Knefelkemp, Liz Shern, and Marcia Taylor.

Finally, projects succeed because of friendly environments. The faculty at the College of Saint Teresa has been a wonderful group of people to deal with in this undertaking.

...Jefferson urged that the people be educated and informed through a broad common-school system and a free press...Education not only would give stability and wisdom to the politics of a commonwealth, but would widen opportunities, bring out the natural talents that could be found in abundance among the common people. Throughout Jefferson's life there runs this humane concern for "the pursuit of happiness," for the development of the individual without regard to limitations of class.

R. Hofstadter
American Political Tradition (1948)

CHAPTER 1

STUDENT DEVELOPMENT

Education is the acquisition of the art of the utilization of knowledge.
Alfred North Whitehead, **The Aims of Education and Other Essays** (1929)

The desire for "higher learning" in the early years of the United States, for "access to the most elevated and most difficult branches of learning," brought about the establishment of numerous academies, colleges, and universities in both municipalities and states "even before the nation had a suitably extensive and democratic apparatus of preparation" for such studies (Boorstin, 1974, p. 478). It was widely believed at that time that young people could achieve their full intellectual and moral growth only by attending institutions of higher education. The reason that such institutions were held in high esteem was the prevailing theory that

> Human nature is plastic; therefore man may by suitable education develop his own rational and moral capabilities...Through proper education man can will to control his baser impulses and translate his innate moral promptings into affirmative social action. Sound early training will discipline the reason and the will for a sound republican society. (Jones, 1968, p. 341)

During the colonial period, higher education followed the classical tradition of English universities; graduates undertook professional studies (e.g., the ministry or the law) or entered upon the life of gentlemen of leisure. Students were graded not by scholastic performance, but by the social standing of their families. Thus, at the end of his first year at Harvard, John Adams was ranked fourteenth in a class of 25 (Bowen, 1950).

The exigencies of nationhood, following the Revolutionary War, also brought changes to higher education. Between 1820 and the Civil War, curricula were revised to emphasize general education (liberal arts) rather than the classics and to include the professions needed in the new society. Subsequently, as the nation began to develop its industrial potential, colleges and universities were exhorted to prepare young people for careers. Professionalism was redefined to include utilitarian skills and the specialties needed in the changing economy; and the general philosophy of liberal arts programs was attacked. The programs managed to survive, however. They proved their value by providing higher education for students with high potential who were not ready to lock themselves into careers prematurely.

Today, students enrolling in institutions of higher education are faced with a variant of that problem: What kind of careers and specializations will be required and rewarded in the future? What kind of training will insure successful and lasting careers?

Throughout history, radical developments and shifts in a nation's economy have brought about adaptive changes in its social structure or the nation has stagnated. Boorstin (1974), for example, characterized the century following the Civil War as "an Age of Revolution" —

> of countless, little-noticed revolutions, which occurred not in the halls of legislatures or on battlefields or on the barricades but in homes and farms and factories and schools and stores, across the landscape and in the air — so little noticed because they came so swiftly, because they touched Americans everywhere and every day. (p.ix)

Education was not only a medium of change but also a source of change in that it supported social mobility. In 1916, when the stresses of the war in Europe were pointing the United States toward a dominant role in world affairs, John Dewey, in **Democracy and Education**, outlined the need for developmental education to prepare students for participation in the postwar world. His observations are just as appropriate today.

A society which is mobile, which is full

> of channels for the distribution of a change occurring anywhere, must see to it that its members are educated to personal initiative and adaptability. Otherwise they will be overwhelmed by the changes in which they are caught and whose significance or connections they do not perceive. (Cited in Cremin, 1964, p. 122).

Sanford (1967), a half century later, seemed to echo Dewey when he argued that all colleges can hope to do to prepare students for the future is to educate them for entry jobs, rather than total careers, and to aim for individual development rather than specialization. "We should seek to develop people as individuals," he wrote, "instead of trying to train them for particular roles in society" (p. 4). He went on to propose that colleges provide

> . . . adaptable intellectual tools, teach ways of approaching problems that are so general and so fundamental that they will serve in a great diversity of situations, and develop in students the flexibility which will enable them to go on learning and to maintain a stable sense of themselves through a succession of changing roles. (p. 4)

Usually, the goals stated in college catalogs echo Sanford's proposals. These goals tend to include

> . . . intentions to promote in students independence of thought along with critical thinking, to make students better citizens as well as to make them more knowledgeable about their cultural heritage, and to help students to understand themselves and relate better to others, as well as to prepare them for a profession. (Brown, 1972, p. 8)

Admirable goals that, unfortunately, are achieved by only some — not all — students!

As early as 1899, W. R. Harper, in an address delivered at Brown University, urged the scientific study of students to further the development of their characters, intellectual capacity and special characteristics, unique capacities and tastes, and social natures (Parker, 1978, pp. 4-5). By the 1920s, a number of psychologists were convinced that testing procedures offered the avenue for such scientific study. In Parker's (1978) survey of the personnel movement at the University of Minnesota, one of the first in the country, he noted the contributions of Donald G. Paterson, a member of the team that had carried out the research program in intelligence testing for the U.S. Army. Paterson himself was a psychologist whose field of interest was individual differences. He believed that "many problems in higher education could be approached systematically, if not scientifically" (Parker, 1978, p.3). He led in the development of better selection procedures at the university, the appointment of faculty counselors, the structuring of a vocational guidance service for women, offices of the deans of men and women, and a testing and counseling bureau (Parker, 1978).

Paterson, however, had intended student personnel services to further the development of students in classrooms, and not to create a new campus bureaucracy.

> Foremost in the minds of Paterson and his co-workers was the intent to facilitate, enhance, and stimulate the greater growth and development of students through more effective education. To them, such services were part of the activities of the regular academic faculty. A keypoint in Paterson's report . . . was the recognition that such services could be carried out most effectively through the academic faculty. In fact, the idea of separating student personnel services from the work of the regular faculty was a contradiction of the basic philosophy of the services. (Parker, 1978, p. 3)

The professionalization of student personnel services on campuses gave to administrative agencies the supervision of students' "emotional, social, and recreational needs" (Parker, 1978, p. 6); quickly, however, the services became identified more with discipline. To defend their "control" of student behavior, personnel workers established the doctrine of **in loco parentis:**

> Since most students are minors in the eyes of the law and . . . spending many hours away from home, it is the responsibility of the institution to act "in the place of their parents." . . . The doctrine was widely accepted and not

often contested openly, that is, not until the mid-1960's. (pp. 6-7)

Professionalization seemed to absolve faculty members of all interest in the holistic development of students and freed them "to focus their teaching increasingly upon their disciplines" (Parker, 1978, p. 6) and to the furtherance of their careers through research and writing. Thus, the idea of student development as an academic function became lost in the hardening of bureaucracies on college and university campuses.

The force behind the current resurgence of interest in student development, according to Parker (1978), was Nevitt Sanford. Although sporadic efforts to study the effect of college on students occurred prior to World War II, it was Sanford's intensive study of the changes in values, attitudes and fundamental aspects of personality in a sample of the class of 1958 at Vassar College that engaged academicians and, especially, student personnel workers. The findings of the Vassar study indicated that compared to themselves as freshmen, seniors on the average,

> ...were less stereotyped in their thinking ... less conformist, less prejudiced, more open to experience, possessed of more firmly internalized values, more sophisticated and enlightened in their views of the world, and more capable of expressing their deeper feelings. (Sanford, 1967, p. 20)

The investigators concluded that many of these changes resulted from the processes of college.

Parker (1978) described Sanford's work as pointing out that

> ...personal development requires an environment in which the forces that challenge an individual's present capabilities are balanced by those that provide personal support....[The] increase in the ability to deal with an ever more complex world in ever more complex ways characterizes development....(Parker, 1978, pp. 7-8)

Sanford's findings permitted him to abstract the differences between education aimed at providing the students with a mass of undigested knowledge and a few specific skills, and education that aims at the fullest development of students for optimal functioning in changing and uncertain circumstances.

> The former [education aimed at knowledge and few skills] begins by asking "what do people need to know?" if they are to live in our world and to ensure its perpetuation: its tendency is to instruct, to train, to mold individuals according to the requirements of our civilization, society, and culture ....The latter kind of education, ...asks what [personal qualities] they should have. It starts with assumptions of what the individual is, and with open-ended visions of what he [sic] can become, and it measures educational progress in terms of change in the personality, for example, from prejudice to broadmindedness, from indiscipline to discipline in thinking. (Sanford, 1962b, pp. 34-35)

Subsequently, Sanford (1967) defined education for individual development as

> ...a program consciously undertaken to promote an identity based on such qualities as flexibility, creativity, openness to experience, and responsibility. Although these qualities depend in part on early experiences, college can develop them further in new ways....(p. 9)

Another concept of student development is offered by Chickering (1972). By surveying the existing literature on adolescent and early adulthood development, Chickering was able to identify seven psychological and social areas which he called "vectors of development." They are (a) competence, (b) emotions, (c) autonomy, (d) identity, (e) interpersonal relations, (f) purpose, and (g) integrity.

The most important vector, perhaps, is the first — competence. Chickering likened it to a three-tined pitchfork of which competence in intellectual exercises, physical and manual skills, and social and interpersonal interactions are the tines and the handle holding the three together is the *sense* of competence, that is, the feeling of confidence one has in dealing with the three areas in particular and one's life situation in general. Thus, the sense of competence is a key element in other vectors of development.

Chickering used the term "vectors of devel-

opment" because "each seems to have direction and magnitude — even though the direction may be expressed more appropriately by a spiral or by steps than by a straight line" (p. 9). The word "steps" is probably analogous to the term "stages" which a number of other theorists have used.

During the same period that Sanford was carrying out his research, W. G. Perry, Jr., Director of the Bureau of Study Council to Harvard University, was tracing the development "in the *forms*" in which students perceive their world "rather than in the particulars of 'content' of [their] attitudes and concerns" (Perry, 1970, p. ix). By using minimally structured interviews, he and his associates were able to elicit from students their perceptions of how the year had affected them and the forms of their cognitive and emotional responses. Over a 15-year period that spanned the decades 1950-1960, he and his associates conducted longitudinal studies of entering freshmen (a total of 84 complete four-year records) and found changes that could be attributed to the college experience.

> . . . [the students] seemed to represent a coherent development in the form in which they functioned intellectually, in the forms in which they experienced values, and in the forms in which they construed their world. (Perry, 1970 p. 8)

The findings led to the formulation of a "Chart of Development" with nine essential positions (comparable to but not defined as stages) that show movement from simplistic to critical thinking.

1. Basic duality. "Assumption of dualistic structure of world [i.e., right-wrong; good] taken for granted, unexamined."

2. Multiplicity: prelegitimate. (Multiplicity perceived, but only as alien or unreal.)

3. Multiplicity subordinate. "Multiplicity perceived with some of its implications....But trust in Authority, at least in the ideal, is not threatened."

4. Multiplicity correlate or relativism subordinate. "Duality restructured in complex terms: right/wrong vs. Multiplicity." or "Relativism perceived in Multiplicity and assimilated to Authority."

5. Relativism correlate, competing, or diffuse. "Relativism perceived as way of perceiving, analyzing and evaluating, not because 'They want us to think this way,' but intrinsically."

6. Commitment foreseen. "Relativism accepted for all secular purposes including binary judgment and action."

7. Initial commitment. "First commitment(s) or affirmation(s). Acceptance of their origins in self's experience and choices, some intimations of implications."

8. Orientation in implications of commitment. "Some implications of Commitment realized: tensions between feelings of tentativeness and finality, expansion and narrowing, freedom and constraint, action and reflection."

9. Developing commitments. "Commitments expended or remade in new terms as growth." (The definitions within quotation marks are taken from Perry, 1970).

A student's progress from one position to another may be interrupted at any time by periods of doubt, fear, or need for a breather. Perry's scheme, in fact, takes cognizance of these needs. To summarize the developmental interruptions Perry wrote the following:

> In any of the Positions in the main line of development a person may suspend, nullify, or even reverse the process of growth . . .: (1)He may pause for a year or more, often quite aware of the step that lies ahead of him, as if waiting or gathering his forces (**Temporizing**). (2) He may entrench himself, in anger and hatred of "otherness," in the me-they or we-other dualism of the early Positions (**Retreat**). (3) He may settle for exploiting the detachment offered by some middle Position on the scale, in the deeper avoidance of personal responsibility known as alienation (**Escape**). (p. 177)

To provide a simplified illustration of the differences between the main concepts of dualism, multiplicity, and relativism, Perry hypothesized a classroom in which each of three students interprets the world from a particular position. The instructor one day lectures on a topic which can be explained by any of three theories. The three students respond from their particular assumptions.

Student A, at the dualist stage, believes that

every problem has one right answer and that knowledge consists of collecting these right answers. Thus the student expects the instructor, by the end of the lecture, to pronounce which of the three theories is the correct one.

Student B is at the multiplicity position. Holding the same assumptions as Student A that there is always a right answer, Student B is slightly more advanced in that he/she has learned that instructors sometimes provide multiple theories or procedures in order for students to learn how to figure things out on their own, to learn to select the correct answer. This student "perceives the lecture as a kind of guessing game in which he is to 'figure out' which theory is correct" (Perry, 1970, p. 2).

Student C is at the relativistic position. He/she has accepted the fact that right answers frequently depend upon context or frame of reference. Committing oneself, therefore, requires one to examine an option's internal coherence, scope, fit with various data, predictive power, and so forth.

If the instructor does not have a particular point of view toward the three theories, Student A may consider that the lecture did not go anywhere, that it offered no "knowledge"; Student B may try polling friends on what they consider to be the "correct" answer in the guessing game; and Student C may go off to the library to investigate the theories further or to think through each option. Did the instructor have a point of view, Student C would have been prepared to consider the three theories in light of that view. Student C may come up with an analysis or synthesis that opens up a new area of conjecture — a very creative development.

If an instructor is to further the development of a student, it is essential that he/she be able to recognize where the student is coming from, that is, from what position the student conceptualizes the world. During the course of the investigation, Perry and his associates "received from young instructors several hundred recordings of their work in section meetings and in one-to-one tutorials" (p. 211). The instructors tended to expect students to approach new subject matter by "sustained groping, exploration, and synthesis" (p. 211). According to Perry, instructors should go beyond judging a student's response as merely right or wrong and should help students to discriminate among possible interpretations of questions or problems.

When an instructor expects students to develop initiative and scope in their thinking, he/she may try to correct errors of thought immediately; however, given enough such corrections, students may become hesitant to chance expressing their thoughts at all. In classes where instructors start out with the intention of encouraging discussion, a few terse, negative judgments of observations by a few students may be sufficient to inhibit all discussion; and the instructor, without realizing how it has happened, finds her/himself lecturing instead of discussing.

One problem, according to Perry is to understand what to correct when. If, instead of pronouncing a student wrong and going on to the next student or next question, an instructor takes the time to find out why a student gives a particular answer, not only the student but others in the class who hold the same assumptions may be advanced along the developmental path.

Perry saw "the most pressing problem" coming out of the study to be the question, **"What environmental sustenance most supports students in the choice to use their competence to orient themselves through Commitments** — as opposed to using it to establish a nonresponsible alienation" (p. 213; author's emphasis)? Some students require no sustenance from the environment and a few are so hostile that they would not accept any environmental support; but for most students, "the most important support seemed to derive from a special realization of community ... that in the very risks, separateness and individuality of working out their Commitments, they were in the same boat not only with each other but with their instructors as well" (p. 213).

Educators must make evident their readiness to risk, and especially to risk making their own thinking visible. Students should be able to see how instructors analyze, synthesize, and generalize new materials, and especially how they grope for possibilities, handle doubts, and figure things out. Instructors also must be confident enough to reveal the styles of their

Commitment. Furthermore, students must be encouraged to become members of the academic community, a state that is achieved by finding meanings, daring to take risks, and showing courage in committing themselves (Perry, 1970). At the same time, it is incumbent upon educators to confirm students' membership at some level in the community.

In short, Perry's findings can be interpreted to signify that the collegiate environment should consist of challenges to students' present capabilities balanced by personal support. This is the kind of supportive environment which Parker (1978, pp. 7-8) found had led to the changes recorded by Sanford among Vassar students.

CONCLUSIONS

Subsequent to the publication of **The American College** in 1962, Sanford found that generally within the academic community,

> . . . very few people would discuss the developmental uses of the curriculum. Everyone agreed that it was important to do more for students than to stuff their heads with facts and principles, but few cared to hear anything that, if accepted, might threaten their interest in research, in advancing their disciplines, or in teaching graduate students. (Sanford, 1981, p. xviii)

Currently, however, members of the academic community seem to be far more receptive to the idea of developmental education. Part of this receptivity can be attributed to social and economic changes since 1962. Other stimuli for the more open attitude may be the interest in faculty development triggered by the Wright Institute in Berkeley, beginning in 1968; the "human potential movement" in psychology which was directed to individual development; and, perhaps most important, "the expanding body of knowledge about adult development in educational settings" (Sanford, 1981, p. xix).

The student development movement has received additional impetus from Chickering and his associates. Because of the present diversity of college students — adults of different ages as well as post-adolescents — student development has been conceptualized by them as part of the broader movement of adult development. In the latter, personality is conceived as an open system in which there are "no dispositions of personality that cannot be changed through education, provided we know enough about these dispositions and the conditions and processes of their change" (Sanford, 1981, p. xx). Thus, Chickering's counterpart of Sanford's earlier work focuses as much on faculty and administrative development as on the development of students of all ages and variety. There is still the problem of "inducing faculties to do what they know they ought to do" (Sanford, 1981, p. xxiii), however.

In the introduction to **The Modern American College** (Chickering, 1981), the author expresses hope for the future of American higher education because of the dramatic increase over the past 40 years in "our understanding of human development, . . . the conditions that encourage and retard it, and . . . the impacts of varied institutional arrangements and human interactions" (p. 5). Specifically, he lists "increased knowledge about how to create environments for learning and personal development that are sufficiently differentiated and rich to be helpful to many different types of students" (pp. 5-6), and "increased understanding of how persons can more effectively take charge of their own lives" (p. 6); included in the latter is the capacity, once the students have learned how to learn, to continue learning outside the classroom.

Chickering also cites the Carnegie Commission's 1972 report, **Reform on Campus,** in which the end goal of American higher education is viewed as an opportunity structure "available to more people . . . and more responsive to the individual needs of the participants" (Chickering, 1981, p. 7).

Opening colleges and universities to diverse students signifies that faculties and administrations can no longer provide assembly-line education, that is, education in which all students are treated as if they are clones of some "typical" student; limit the options for learning; maintain a narrow range of instructional practices, for example, lectures and traditional laboratory procedures, regard campuses as ivory towers that are dissociated from the market place; and expect students to

accept such conditions or to leave (see also Chickering, 1981).

However much we may recognize the need for institutions of higher education to change, we still recognize the fact that institutions cannot be reformed overnight, even by directives. Change, to be effective, must originate internally, must be encouraged by one or more persons who can influence their peers, must not threaten anyone, and must be perceived as personally rewarding. Thus, if student development is to be initiated on any college campus, the first step is faculty development, that is the re-education of faculty members and administrators in the desired direction. An example of such development is presented in Chapter 4 in the account of the experiences at the College of Saint Teresa with the group that named itself "Perry's Pioneers," and in the description of the college's "Design for Choicemakers" program.

Sometimes it is possible for one person or one course to trigger interest in student development. At CST, the changes began with the Unified Science sequence and the process skills They are described in Chapter 2.

CHAPTER 2
TEACHING SCIENCE THROUGH REASONING

What we have to learn to do we learn by doing.
Aristotle. ***ETHICA NICOMACHEA,*** *ii, 1.4*

From 1971 to 1975 the College of Saint Teresa (CST) received funding from the National Science Foundation (NSF) under its Undergraduate Pre-Service Teacher Education Program (UPSTEP) to develop and field test a unified science model for education majors. In 1975 the model was recognized by the American Association of Colleges for Teacher Education as one of the top 10 teacher-education projects in the country.

The unified science program became a three-term sequence which is still part of the teacher-training curriculum at CST. Before 1971 all elementary education majors were required to take traditional courses in Biological Science, Physical Science, and Elementary Science Methods. In the Unified Science sequence the three areas are combined within a single methodological structure and are taught by three faculty members (a biologist, a physicist, and a science educator; they also have credentials in chemistry, astronomy, and earth sciences, respectively). The methodological structure comprises a number of process skills: **observing, inferring, measuring,** and **classifying; using numbers and space/time relations; communicating, predicting and formulating hypotheses; making operational definitions and interpreting data;** and **controlling variables and experimenting.** These skills were identified by the Commission on Science Education of the American Association for the Advancement of Science (AAAS) as being representative of problem-solving activity (Gagne, 1970). Gagne considered the skills to form a hierarchy by which observing, measuring, inferring, predicting, classifying, and collecting and recording lead to interpreting data, controlling variables, defining operationally, formulating hypotheses, and experimenting.

The process skills are part of the methodology of modern scientific research and are elements of what the Education Commission of the States (1982) called the "basic skills needed to function in tomorrow's world: critical thinking, problem solving, analysis, synthesis, decision making, communication." The ultimate goal of the Unified Science sequence is to prepare education majors to develop and/or enhance the process or reasoning skills of K-8 school children.

BACKGROUND

When the USSR launched the first artificial space satellite on October 4, 1957, the event triggered the beginning of the space age. At the same time, in the United States, certain educational problems which had been barely contained up until then erupted. Acrid criticisms were directed especially at the teaching of science and mathematics in the elementary and high schools and at the preparation of science and math teachers in colleges of education. Although tremendous strides had been made in all scientific fields during the war, these advances were not reflected in the methods or contents of science and math courses in the schools. In short, despite all the money allocated to education, the United States seemed to be lagging behind the Russians in the preparation of students for new roles in science and space age technology. The fears may have been unrealistic to a considerable degree, however. Many of the rocket specialists then working in Russian science centers were Germans who had brought their skills with them; it is quite likely, therefore, that Russian schools were little better on the whole than American schools.

Congressional interest in the development of science in the United States had been manifested earlier. In 1950, that body had founded the National Science Foundation to promote a national science policy through the support of basic research and education in science. Thus, the decade of the 1950s ended with the National Science Foundation sponsoring a number of projects for the writing of new and better science curricula for K-12

pupils. The new generation of science projects was directed to developing in students the ability to solve problems by usings scientific methods. As the curriculum for each grade was written, teams of college and university scientists who had participated in the project went out to classrooms in various centers across the country to test student reaction to the new courses.The response seemed to be highly positive and students showed measurable gains in science achievement. With these results in hand, the projects began to publish the materials they had developed for broad dissemination and school systems were encouraged to adopt the new curricula.

It was at this point that an unexpected problem surfaced. Despite the intensive workshops that were conducted to introduce the new curricular materials, teachers did not seem to understand their purposes or contents or the assumptions or methods on which the materials were based. The new science curricula were based on inquiry skills which most teachers had neither learned nor understood. Few teachers had ever been exposed to the principles of scientific thinking or research. In fact, the teachers needed a great deal of inservice education during the course of a school year, and sometimes for longer, to be able to follow the course guides. Therefore, summer institutes were organized to train teacher educators in the new curricula so they, in turn, could train preservice teachers.

PROJECT UPSTEP

At CST, in the meantime, a physicist who taught a sequence of elementary science education courses, was carefully observing the students in her classes and noting their responses to the established curricula. The most pervasive problems were that students manifested considerable difficulty in remembering materials from one term to the next and in grasping scientific concepts. When the physicist discussed the problem with a biologist who also participated in the elementary science education program, they came to the conclusion that if they were going to revise science education at CST, they might as well attack the basic problems and, in effect, start afresh rather than try to revise and patch up the traditional courses. It was no longer enough to teach facts and information to pass on to elementary school pupils; what was needed was a shift to new methods and concepts and materials. In other words, the two faculty members conceptualized courses based on the idea that **if you want teachers to use certain methods in elementary school classrooms, then you must use these methods to teach the teachers.** At the same time they decided that since there was so much overlap among the various sciences, a sequence of courses in which similarities and fundamental concepts were stressed would be more productive than separate courses. So the idea for the Unified Science sequence was born.

The physicist and biologist wrote a proposal for a project to develop their ideas and sent it to the National Science Foundation. Specifically, they proposed a three-term sequence of science education courses in which education majors would learn to use methods of inquiry in elementary classrooms. The National Science Foundation liked the idea but asked for some programmatic revisions. That was in November 1970. In the following month, the program developers, although they had no financial support, set up the pilot project. Seven months later National Science Foundation awarded the college a two-year grant. A science education specialist with credentials in the earth sciences, was brought into the project to write modules and expand the range of the course content. The results of the first year of operations were encouraging enough for National Science Foundation to renew the grant for an additional two-year period in June 1972, which meant that the project was assured of funding to 1975.

From the very beginning, the new science sequence seemed to be popular with the education majors. They were especially responsive to the characteristics of the sequence and the built-in combination of freedom and personal responsibility, qualities that were highly esteemed by students during the early 1970s. The methods of inquiry, however, seemed to present difficulties. Different ways of teaching the methods to CST students were tried but none succeeded. Then, after about two years, the basic problem was identified. Most of the education majors who were being prepared to teach elementary school children to use process skills did not understand the

principles on which the skills were based and did not have the capability to use process skills themselves. Changes were obviously required.

Thus, almost in midstream, the science sequence was given a broader focus: to raise its students' reasoning capacities. In short, the faculty instructed the preservice teachers by the same methods which the teachers would use in classrooms to teach children. To make this shift possible, the faculty members instituted the practice of conferring with students whenever they needed help and of employing questions to stimulate reasoning about difficulties rather than "telling" students. Furthermore, students working in teams were expected to question themselves and each other on the conduct of investigations and the reaching of logical conclusions. Most of the students seemed to profit from the new focus.

THE FEATURES OF UNIFIED SCIENCE

The end product of Unified Science is best illustrated by its **Teacher's Guide** (Battaglini, Horner, & Pirkl, 1975). The course sequence is described as semi-individualized; self-paced; modular; competency based; inquiry-oriented; closely aligned with ESS (Elementary Science Study), SAPA (Science: A Process Approach), and SCIS (Science Curriculum Improvement Study); humanized; "hands-on"; easily adapted to the elementary classroom; and, of course, heavy in process skill development. The "unified" aspect of the course derives, according to the authors, from a two-fold concept.

> First, the general disciplines of the biological and physical sciences are incorporated with process skill development in a unified manner throughout the sequence. Second, and we feel more important, . . . the methodology of teaching science to children is an integral part of all three courses. (p.2)

In other words, the course taught in the college classroom follows the same style and methodology as those designed for use in elementary classrooms. Some of the written objectives in the college sequence, consequently, are suitable for use with children.

The course is characterized as **semi-individualized** because students work with partners; together they may elect to perform a certain number of instructional modules in addition to those that are required. The students work at their own rate **(self-pacing)**; to accommodate them, the labs are open 13 hours a day. The **instructional modules** (MODS) include behavioral objectives, identified process skills, itemized sets of materials, and procedures. Each MOD tray holds all the simple equipment needed to attain the objective of that particular experiment. (At the time the **Teacher's Guide** was published, the course included 141 MODS.)

In each MOD, the behavioral objective is a **competency** which, as a rule, the student must demonstrate for an instructor. The number of competencies attained each term determines the letter grade assigned to the student. The MODS are **inquiry oriented,** that is, they are rooted in the Socratic method of questioning to find out how and why a student has reached a particular position or conclusion. During the third term of the sequence, preservice teachers are given considerable information on how to elicit meaningful questions from and to ask more meaningful questions of children in elementary classrooms. Learning how to question and respond to children, whether their answers are right or wrong, is a very important part of the curriculum; the purpose of these questioning skills is not so much to obtain "right" answers as it is to open children to awareness of the reasoning by which they reach their answers.

An important part of the teaching process has been the **humanizing** of relations between faculty members and students. Faculty members make themselves available to students throughout the day by appointment; the latter may be for a quick consultation, a demonstration of competency; or a teaching session. This ready access in response to students' needs gives both faculty members and students ample time and opportunity to develop person-to-person relationships, improve communications, and expose their strengths and weaknesses without fear. An attitude of mutual support and cooperation develops early in the sequence, consequently. Although the idea has not been tested, it is quite likely that the students' positive experiences and feelings of competency engendered in interactions with

the Unified Science faculty members carry over into other courses and activities.

The **hands-on** nature of the MODS enables education students to learn to handle different kinds of materials and devices with confidence. More important, perhaps, students learn to appreciate the possibilities for creativity in the various materials. Most equipment in the MOD trays are designed for **use in elementary classrooms;** they include such simple and familiar objects as straws, washers, seeds, magnifiers, flashlight cells and bulbs, and electrical wire, for example. The elementary nature of these materials is no deterrent to significant scientific experiments or to playful explorations. For children, there is often only a semantic difference between having "fun" and investigating properties of different materials in a scientific fashion.

In the third term of Unified Science, the education students participate in practica in which they teach science to peers and children. They also review relevant literature in group seminars; during the latter, the students explore ideas on the philosophy, methodology, and psychology of teaching science to children, and reinforce their skills of analysis, synthesis, and application which are developed by the inquiry method.

The **Teacher's Guide** to the Unified Science sequence (Battaglini et al., 1975) expands in some detail on the concepts and principles which have been briefly outlined in this section. The discussions cover each part of the sequence, the instructional MODS, the process and methodological competencies for which students are expected to strive, teacher notes on specific MODS in each term of the sequence, and pre-assessments and final assessments of the competencies.*

EVALUATION

Did the use of process skills in teacher preparation make a difference? John Renner of the University of Oklahoma, a pioneer in the use of process skills in science education, became interested in conducting an objective investigation of the effects of using process skills and inquiry methods in preservice teacher education across a range of programs from those in small private colleges to those in large public universities. The National Science Foundation awarded him a grant (#75-..-0517); it permitted Renner to do a study of the effects of CST's Unified Science sequence which had been started with an UPSTEP grant. A similar but separate investigation was carried out at Purdue University (Renner & Lawson, 1975).

Previously, Renner had adapted Piaget's investigatory techniques for use with college students; thus he had both a conceptual framework and experience to bring to the investigations. At CST, to start the study, he pretested two random groups of students: 19 sophomores in the UPSTEP program (the experimental group) and 17 sophomores with majors in other fields (the control group). Renner did not learn which students were members of which group until the posttest data were analyzed. Three Piagetian tasks were administered individually to the 36 students; they are "The Separation of Variables," "The Exclusion of Variables," and "Equilibrium in the Balance." An additional ability, "Conservation of Volume," was tested in writing. The following year Renner returned to administer the posttest. Unfortunately, some attrition had occurred in the ranks of each group: The experimental group was reduced to 16 students and the control group to 12, losses of 16% and 29%, respectively. Because of the small size of the final sample, the results of the analyses cannot be generalized.

The Piagetian tasks had been designed to place students into one of four categories of thought established by Piaget. They are:

II A — Early concrete operational
II B — Concrete operational
III A — Early formal operational
III B — Formal operational

However, because of the small sample size, the CST data were analyzed only for placement in the concrete or formal categories. Table II-1 displays the results of the analyses.

Note that between 1974 and 1975, whereas the experimental group showed a decrease in the concrete category and a corresponding increase in the formal category, the control

*(Copies of the **Teacher's Guide** are available from Chair, Division of Sciences & Mathematics, College of St. Teresa, Winona, Minnesota 55987.)

TABLE II-1

EFFECTS OF UNIFIED SCIENCE METHOD ON STUDENTS' COGNITIVE DEVELOPMENT

PIAGETIAN CATEGORY	EXPERIMENTAL GROUP (UPSTEP Students) 1974	1975	CONTROL GROUP (Other Students) 1974	1975
II Concrete Operations	74%	50%	16%	42%
III Formal Operations	26%	50%	84%	58%

Source: J.W. Renner. The determination of intellectual levels of selected students. Final report to the National Science Foundation, P.O. #75-SP-0517, 1975.

group showed a reversal; that is, performance in the concrete category increased over the one-year period while that in the formal category decreased correspondingly. These data were consistent with the parallel study which had been carried out at Purdue University (Renner & Lawson, 1975).

Renner summarized his findings at CST as follows:

> The data in Table 1 clearly show that the percentage of abstract thought used by persons who enter the field of elementary education is lower than that used by persons entering other fields. The data also show that the potential for developing formal thought exists in those majoring in elementary education. [Faculty members] in charge of such programs must utilize techniques to activate that potential. The inference that the techniques used with other types of college students will probably not activate formal thought in elementary education students seems proper. Those techniques do not activate as much formal thought in non-education students (who were using formal thought more times than the education students did) as was activated by the inquiry techniques used with education students. Before the foregoing inference could become a generalization data would be needed which compared education and non-education students who began the experiment at the same levels and who were taught, respectively, by inquiry and the usual college teaching techniques (probably lecture and verification laboratories).

In the next section, we look closely at higher order thinking skills as such.

LEARNING SCIENCE: K-12 and HIGHER EDUCATION LEVELS

A main difference between the preoccupation with education during the 1950s and the present is in terms of who should benefit. At the time the Russians launched Sputnik, the integration of races in the same classrooms was just beginning and the courts were not yet concerned with the educational rights of handicapped students, disadvantaged children, women, and other minority groups. Thus, the goal for educational enrichment was the development of an elite of bright minds—of young men with high science and math aptitude who would work to surpass Russian technology. Today, however, the goal has been broadened; not only do we need to find and stimulate students with the highest potential but, also, to develop the potentials of all children. A broad base of citizens who understand science is essential for the support and maintenance of any technological society. Excellence and equity are both called for today.

The report by the National Science Board (1983), "Educating Americans for the 21st Century," states,

> ...the new basics are needed by *all* students—not only tomorrow's scientists—not only the talented and fortunate—not only the few for whom excellence is a social and economic tradition. All students need a firm ground in mathematics, science, and technology. (p.v)

The National Science Board recognized that substantial portions of our population still suffer from the consequences of racial, social, and economic discrimination, compounded by watered down standards, social promotion, poor guidance, and token efforts. Nevertheless, the board found that virtually every child can develop an understanding of mathematics, science, and technology if they are appropriately and skillfully introduced at the elementary, middle school, and secondary levels. It is fitting, then, to look at the current state of science education in the public schools and to ascertain how the needs of K-12 pupils relate to teacher-preparation issues.

Robert E. Yager, head of the Science Education Center at the University of Iowa, attributed the true "crisis in science education" to the textbooks which have been commonly used for decades (Mitgang, 1984). The problem, he elaborated, is not teaching too little science, but, rather, the wrong kind of science: science that is technical, full of jargon, and of little use to the average student.

One study indicated that between 2400-3000 new vocabulary words are introduced in a secondary science course, nearly twice the number introduced in a foreign language course. This rate of introduction, calculated on a 55-minute period of science per day, means that a term is introduced every two minutes. One student reflected on his high school textbook and stated, "It's a damned dictionary" (Rowe, 1983).

Rowe also charged teachers with operating implicitly according to a model of learning that views students as bottomless receptacles of information. The teachers' function is to convey information and correct students' recitations of the information they recollect. Knowledge is seen as a fixed commodity to be stored for future use ("Learn it now, you'll need it next year; learn the official story, regardless of whether you believe or understand it"). Somewhere, students learn, there are people who produce "right" answers.

Rowe's insights are echoed by Arons (1983) who stated that when declarative knowledge (i.e., facts; information) is received from authority figures it is accepted as representing the ultimate truth. This kind of thinking is the very opposite of what is needed in science education today.

What should be learned in science and why are described by Arons (1983). Science requires the acquisition of declarative knowledge—learning facts, for example, that the earth revolves around the sun—but it also requires the acquisition of operative knowledge, that is the understanding of the source of declarative knowledge (How do we know the earth revolves around the sun? Why do we accept this view?), and the capacity to use, apply, transform, or recognize the relevance of declarative knowledge in new or unfamiliar situations.

Science is learned, in Arons's (1983) view

> ...to develop the sense of how concepts and theories originate; how they come to be validated and accepted; and how they connect with experience and reveal relationships among seemingly disparate phenomena; and to reflect on the scope and limitations of scientific knowledge and of its impact on our intellectual heritage and view of man's place in the universe. (p.96)

Unfortunately, most students learn about science as something done by somebody else rather than something that can be incorporated into one's own way of thinking. They know scientists are likely to examine their conclusions and change them in the light of new evidence, yet students seem not to be willing to act on this knowledge when they themselves encounter problems. This attitude stems from the fact that in American schools today, most children are learning only declarative knowledge although they need to learn and use operative knowledge if they are to participate in making tomorrow's world.

The very charges leveled against K-12 science education continue to be directed at college science instruction. Stake and Easley (1978) concluded that

> ...science was something teachers took in college, but it was not something they experienced as a process of inquiry. Further, it is not likely that the crucial attitudes in the valuing of empiricism as an important and necessary information getting mechanism will be transmitted to science students. The teacher needs experience in conducting investigations, knowledge of various inquiry skills, the awareness of many

sources of information; and the ability and experience in interpreting, analyzing, and evaluating information, and in decision making which utilizes this information.(p.12:7)

From his experience with science education at both the preservice and inservice teacher levels, Arons (1983) concluded that teachers' knowledge of science resides exclusively in memorized names and technical terms. Because they lack operative knowledge, they cannot reason. The majority are concrete thinkers who cannot control variables or visualize possible outcomes of change imposed upon a system.

Arons further generalized his observations on the dearth of opportunities for using operative knowledge in the undergraduate program. He considered declarative knowledge to be the mainstay of college and university training. "There is increasing evidence that our secondary schools and colleges are not doing a very good job of cultivating *operative* knowledge in any of the formal disciplines" (p.94).

Striking similarities can be found between declarative knowledge and Perry's first position: dualism; and between operative knowledge and Perry's fifth position: relativism. Remember Student A (professor, please tell me what is the right answer) and Student C (there are many ways to look at this theory) described in Chapter 1?

Research on the Perry mode corroborates the conclusions of both Stake and Easley and Arons.

Parker (1979-80) and his research team found that at the University of Minnesota (a typical state university by all accounts), few students were at the relativistic position. Welfel (1979) described graduating college seniors as showing (a) little evolution of alternative views on any issue; (b) tending to treat all opinions as equally good; (c) tending to hold opinions based largely on whims or unsubstantiated belief; and (d) hesitating to take a stance or commitment based on evidence and reason.

Parker (1979-80) concluded, "these results correspond to a growing body of evidence that higher forms of intellectual development are not as common in undergraduates, even seniors, as most professors assume" (p.6).

Are these unrealized intellectual levels a function of cognitive development or of teaching at the declarative knowledge level?

In considering the probabilities of the alternatives—(a) K-12 and even many college students fail to learn operative knowledge because they are not developmentally ready, or (b) Kindergarten through higher education reinforces declarative learning and extinguishes the use of and/or fails to teach operative knowledge—the latter is the more optimistic explanation of our failures. It is also supported by the findings of researchers (e.g., Parker, 1979-80) that developmental training in classrooms can advance some students' abilities to deal with complexities. Thus, our institutions of higher education are challenged to raise the level of instruction from declarative knowledge to operational knowledge, in short, to introduce the inquiry method in teaching just as CST did in the Unified Science sequence.

The difficulties in science education can be laid at the doorstep of teachers and instructors who are unable to foster operative thinking in their students. This conclusion supports, in part, the cylical nature of the problem: Teachers graduate from college with the perception that science exists only at the declarative knowledge level and do not understand the importance of operative knowledge/process skills. In turn, they teach science in the declarative mode...and so on.

CONCLUSION

Jefferson and Dewey looked beyond economic necessity when they respectively called for the full development of American citizens as contributions to society in general and the individuals in particular. Economically, however, the agrarian and industrial societies needed few well-educated people. In fact, it has been suggested that too many fully developed individuals are obstacles in an industrial society (Goodlad, 1979).

The need today for people who are skilled in declarative and operative knowledge is not voiced because the United States is at the peak of a human potential movement but, rather, because people who possess these cognitive skills are necessary for our economic survival in an increasingly complex and competitive technological world market.

The description of the Unified Science sequence in this chapter proves that inquiry skills—operative knowledge—can be taught by trained instructors and can be learned by college students. The first two years of the project also proved without a doubt that preservice teachers cannot be prepared to teach inquiry skills if they do not possess these skills themselves. It is possible that the failure of our schools to teach science as it is needed today rests with the teacher-education programs that do not ascertain whether teachers possess the skills to carry out the task in classrooms.

In Chapter 3, the use of operative knowledge is shown to be the necessary stock in trade of the professional called "Teacher."

CHAPTER 3

REASONING SKILLS: THE FOUNDATION OF REGULAR AND SPECIAL EDUCATION

A curriculum should involve the mastery of skills that in turn lead to the mastery of still more powerful ones . . . .
J. S. Bruner,
Toward a theory of instruction (1966)

The express purpose of PRISE (Preparing Regulars In Special Education), the project funded by the Bureau of Education for the Handicapped under the Dean's Grant Program, was to make special education content a part of the regular curriculum in order to prepare future teachers to cope with the instructional needs of children with mild to moderate learning handicaps who, by law, must be educated in mainstream classrooms. During the first year of funding, consequently, the project director spent his time auditing courses to ascertain appropriate curricular areas in which to insert special education content. The analysis led to several conclusions that, in subsequent years, were to give PRISE an unexpected and unique direction and liberal arts outcomes a new importance in the teacher-education curriculum. The changes initiated in the latter by PRISE and supported by the dedicated college faculty also suggest a solution to the problem of teacher-training institutions that cannot cram additional content into existing courses.

It is a tribute to the Office of Special Education, which superseded the Bureau of Education for the Handicapped in the U.S. Department of Education, that its personnel encouraged the directions taken by PRISE and thereby fostered the structuring of a development-based liberal-arts-oriented teacher-education program for the College of Saint Teresa.

BACKGROUND

The passage of Public Law 94-142, The Education for All Handicapped Children Act of 1975, was essentially a manifestation of the national policy to eradicate all forms of segregation from the public schools. The law expanded that policy, however, by mandating how it should be carried out: by including handicapped children in regular classrooms (the principle of placement according to the least restrictive environment for each handicapped pupil) and adapting instruction to the individual needs of handicapped pupils (the principle of individualized educational planning, i.e., IEP). These principles and other substantive provisions in the law had already been spelled out by the courts in a number of states and the District of Columbia (see Weintraub, Abeson, Ballard, & Lavor, 1976).

In anticipation of the enactment of the measure, the Bureau of Education for the Handicapped initiated the Dean's Grant program in 1974; its purpose was to stimulate teacher-training institutions to "investigate alternative solutions to the various problems emanating from the need for change in teacher-preparation programs" (Behrens & Grosenick, 1978, p.1). Project proposals were expected to include three basic elements: direction of the project by the college dean or department chairman in order to support the project with his/her "authority, responsibility, and decision-making capability to bring about change"; development and conceptualization of "new ways for the preparation of the teachers of tomorrow"; and the involvement of the entire college or department faculty in the revisions (p.2). The level of funding for each project was deliberately limited to seed money to discourage the adoption of measures that clearly would be beyond the capacity of the institution's instructional budget when project funding ended.

The law became effective in 1977. During that year a new CST faculty member was teaching courses in learning disabilities which led him to conclude that it was senseless to have separate special and regular education courses in teacher-preparation programs when all teachers could benefit from sharing a common battery of techniques and skills in working with mildly handicapped learners. This

conclusion was based on his observations as a school psychologist, learning disabilities teacher, and special education administrator: The major problem confronting most pupils who are labeled "LD" is that they have had poor reading instruction. While he was looking for sources of funding to investigate this observation he learned about the Dean's Grant program. It was, he realized, a program that could bring the two strands of education together.

The learning disabilities instructor discussed with his colleagues the purpose of a Dean's Grant project and the kind of design that would be advantageous for CST. With their co-operation he put together a proposal in which he would serve as director. The major elements of the design centered on curricular modifications to incorporate specific special education content and procedures in regular education courses and a shift to the assessment of students' acquisition of desired skills. In order to set the stage for making changes, the design included a two-week workshop for faculty members; during the first week, the Dean's Grant director would present an overview of broad cross-categorical special education (which he taught in the learning disabilities minor concentration) and related teacher competencies; during the second week, faculty members would review the content of the courses they taught and develop a planning matrix to match regular education course content with the competencies for dealing with mildly handicapped students. From these matrices, and from additional faculty inservice and field work, changes in the course work would be made.

The field work proposed was a one-quarter leave for all five education faculty members during the year to permit them to acquire hands-on experience with handicapped children in the Winona District Schools. The inservice component was a plan for the project director to work cooperatively with faculty members for each of three terms in one academic year to help them to revise their courses and organize new course formats. The project director also planned to conduct monthly workshops during the year on topics relating to the provision of services for mildly handicapped pupils in regular education classrooms.

The federal agency approved the end product of the proposed project (integrating compatible special education with regular education courses) but rejected the field work provision. More important, the field readers and project officer urged the adoption of a substantive alternative in place of the proposed second workshop week. They favored a more thoughtful and objective approach to identifying the logical integration of regular and special education content, specifically, that the project director analyze the content of core education offerings by auditing the regular education courses during the first year. Then, on the basis of the data he would collect and the insights gained by faculty members during the monthly workshops, he and the faculty would be able to complete a better course content/special education competencies matrix during the second summer.

These recommendations were accepted by the education faculty and the first workshop week was held in the summer of 1978. CST received an initial grant of $17,000 ($200,000 over the six years) for the operation of PRISE and the learning disabilities instructor was named Project Director, the office he held for the six years of the project's life.

PROJECT ACTIVITIES

Overlapping and Duplicated Course Content

During the first two terms of the first year the project director audited six courses: Unified Science, Introductory Psychology, Reading Methods, Math Methods, Interaction Laboratory, and Education Today. A substantial percentage of instructional time, he found, was duplicated effort. For example, the Piagetian stages of development and their implications were covered in similar fashion in four courses for a total of eight clock hours. Comparable repetitiveness was found with other content. Even under the guise of a spiral curriculum this degree of duplication cannot be justified. However, by identifying the unwarranted duplication and overlap of materials, the first step was taken to freeing time for the infusion of new and additional course content or for giving students more time to master present current content.

Another outcome of the course audits was the realization that considerable similarity ex-

ists between regular education and special education content. Contrary to the initial expectation that much new content from special education would have to be added to regular education courses, the differences between the two curriculums were found to be minor. The introductory psychology course, for example, devoted considerable time to areas that relate to special education, such as sensation and perception, genetics, intelligence, and learning theories; only slight modification in lectures or a few additional readings were needed to make this course applicable to all pupils. More important, there was no need to study the "psychology of handicapped children" separately from "child development" because the same theories of psychology apply to all children. The separation of handicapped from other children occurred at the time that handicapped children were considered to be constitutionally different from other children and, hence, required different theories. Subsequently, the separation was institutionalized because of the beliefs and not because of evidence.

> [It was widely believed that] people trained to understand and work with retarded children could not (should not) work with normal children, and vice versa. . . . The opposition to mainstreaming [retarded] children was long contained in the political-administrative-social structure of departments and schools of education in our colleges and universities. (Sarason & Doris, 1978, pp. 8-9)

The most striking similarities between special and regular education existed at the level of pedagogy. The project director, as a special educator, had been trained in a generic cross-categorical approach to educating mildly handicapped children. He had been taught that Bateman's (1971) *Essentials of Teaching* (**O**bjectives, **T**ask Analysis, **T**each [materials and management], **E**valuation and **R**ecycle: OTTER) were the stock in trade of a special education teacher. During his audits of regular education courses, however, he realized that OTTER contained little that was new. In fact, it paralleled the instructional model which CST faculty members consistently used to convey information to students throughout the program. For instance, in a CST sophomore-level educational psychology course, five principles of teaching (see Glaser, 1962) were taught to the students. They are,

1. Develop clear and precise instructional objectives.
2. Measure entering behavior to determine how far each student has already progressed toward the objective (the way she or he studies it, his or her motives, etc.).
3. Develop instructional procedures that base current learning on each student's entering behavior.
4. Measure each student's progress toward educational goals.
5. If one or more students have not reached the goal, provide additional instructional goals or methods of assessing entering behavior.

Despite the difference in language and representation, both Bateman's acronym and Glaser's principles are similar and, what is more important, are variations of a model first proposed by Tyler (1950) and elaborated later by Taba (1962) and Popham and Baker (1970). The model specifies four essential steps for effective planning:

1. Specify objectives
2. Select learning activities
3. Organize learning activities
4. Specify evaluation procedures

Clark and Yinger (1978) called the model "basically a rational means-ends model in which a planner's first task is deciding what is to be accomplished and, then, selecting the appropriate learning activities to accomplish it" (p.3). They cited Taba's conclusion that "curriculum is characterized as a task that requires orderly and careful thinking" and that the model under discussion is "a rational and scientific method for accomplishing such a task" (Clark & Yinger, 1978, p. 3).

When the project director recognized the instructional similarities in the regular and special education programs he found it easier to talk with faculty members about what was being done in common.

To sensitize the education faculty members to duplicated content, therefore, they were urged to think in terms of course-content objectives revolving around an accepted se-

quence of competencies. As a start, they were asked to set out their objectives for common strands in the education curriculum, for example, intellectual development, behavior in classrooms, and discipline. Then, by studying these objectives, they could discern the extent of overlap and the starting point for making changes. Whatever correspondence was found in different courses would become the focus for further faculty discussion.

In any venture in restructuring education programs to prepare teachers to serve a diverse population of pupils in regular classrooms, the end goal is to equip the preservice teachers with specified competencies. To meet this goal the instruction provided in the college classrooms should be directed to the competencies and to methods of evaluating whether students have acquired them. To meet these criteria, a new program structure was developed at CST for the elementary and secondary programs; it is shown in Figure III-1. The model is interdependent and based on the rational means-end format. Thus, assessment, objectives, class management, planning, class presentation, and evaluation are held to be the important functions of teachers. The programmatic structure distinguishes the initial content presentation from the application of that content across the range of subsequent courses. In the CST structure, the approximately 1500 course objectives that had existed prior to PRISE were reduced to 56 major content units and 10 forms of content application (see Fig. 1). When faculty members changed course content, all other faculty members were informed; this principle of interdependence encouraged communication and cooperation.

By specifying the interdependence of particular areas of theory and application, faculty members are able quickly to identify the content that is covered in other courses and which students should have mastered. Thus, class time can be spent on new content. This interdependent model frees instructors from the burden of exploring how much or how little students have learned in other courses and, at the same time, gives students a better understanding of the rationale of the program and its unified curriculum.

The following seven steps for the modification of any teacher-education curriculum were developed out of the experience at CST. These steps permit the infusion of new content in courses where it is needed within the total curriculum design.

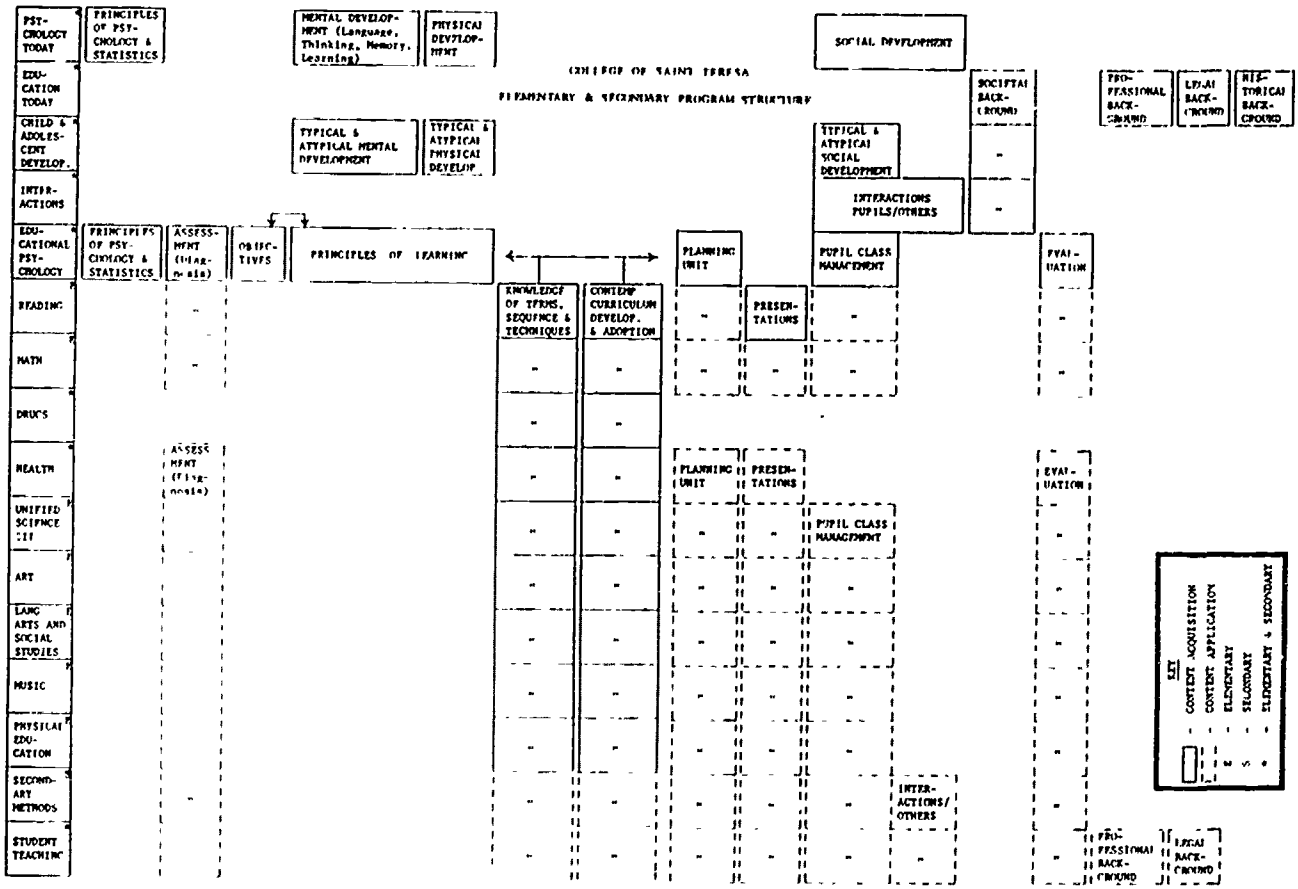
1. List objectives for each current course.
   a. Scrutinize entire teacher-education program. Focus especially on what students expect the outcomes to be and what the instructors' goals for the students are. Do not use catalog course descriptions.
2. Study the sequence of objectives and ascertain where overlap is present.
3. Sort objectives necessary to meet programmatic requirements into courses with the highest degree of match.
   a. Follow the NCATE standards in clearly stating programmatic objectives; design the curriculum to achieve those objectives; and adopt an evaluation procedure to monitor achievements.
   b. Specify competencies to be attained by students; be sure that the proposed competencies are not restatements of old expectations.
   c. Set priorities on new material which should be infused in the curriculum.
4. Ascertain if faculty inservice sessions are needed to facilitate course modifications.
   a. Encourage faculty members to recognize gaps in their competencies.
5. Modify students' clinical experiences (practice teaching and field work).
6. Specify how graduates of the teacher-education program will be expected to use their acquired skills and knowledge in classrooms.
7. Institutionalize changes in courses through interrelated syllabi.

(For a detailed description of these seven steps, see Shelley & Schenkat, 1983, pp. 38-41.)

In sum, the duplication and overlap of content in education courses at CST were deleted and special education content was infused in regular education courses by focusing on (a) the objectives of each course, (b) the

FIGURE 1

Chronology of coursework from freshman year through first quarter of senior year student teaching, showing content acquisition and content application, in elementary and secondary education programs at College of Saint Teresa.



competencies students must attain, and (c) the sequence in which the competencies should be attained. At the same time, the elimination of overlap cleared time for more efficient instruction when new content was not needed. The areas of regular and special education that are closely akin to each other were reconceptualized as continua of development and behavior rather than discrete; when discrete areas were identified, they were studied to ascertain what special education techniques could contribute to restructuring teacher training. An important aspect of the work was making certain that language difficulties and the level of mastery expected of students did not impede the developing proficiencies.

Relation of Process Skills to Regular and Special Education

An exciting happenstance for the project director early in the first year was the discovery during the course audits that the process skills taught in the Unified Science sequence were directly applicable to the development and implementation of individual educational plans (IEPs) for handicapped pupils, and to lesson planning in regular education. Interestingly, this discovery came while he watched a junior-level science methods class conduct a sixth-grade science unit from **Science: a Process Approach.** His observations led him to speculate on the thinking processes (e.g., observing, classifying, hypothesizing, controlling variables, experimenting, measuring, recording) the students were using and the fact that these same processes are seldom applied by teachers in classrooms.

Was there a possibility of enhancing teachers' decision-making skills by making a direct application of the process skills taught in Unified Science to the act of teaching in general? Could the process skills be useful beyond science education?

The project director and the science education specialist realized the need for students to

TABLE III-1

RELATION OF A SCIENTIFIC APPROACH,
IEP DEVELOPMENT, AND RATIONAL MEANS-END MODEL

Scientific Approach	IEP Development	Rational Means-End Model
Observation	Assessments	Informational Processes
Classification	--	--
Inferences	Recommendations	--
Design Experiment	--	--
State Hypothesis	Behavioral Objectives/ Activity	Select Learning Ability
Operationally Define	Behavioral Objectives	Specify Objectives
Control Variables	Specific Activity	--
Experiment	Implement	Teach
Measure	--	--
Record/Communicate	Evaluate	Specify Evaluation Procedures
Predict	IEP Dates	Completion Date for Units

Source. R.J. Schenkat (1981, summer). The place of teacher preparation in meeting the needs of all children in an austere decade. **National Aposolate with Mentally Retarded Persons** (NAMRP) **Quarterly**, p.6.

become facile in the use of process skills as problem-solving tools. They were heartened by an affirmation of this idea from Barbara Bateman (1981): "I have found that knowing about the essentials of teaching and being able to apply them in a problem-solving way are not the same thing for large numbers (about 95%) of teachers. I'm also struck by the fact that we seem to evolve repeatedly toward recognizing that without specific teaching lots of people just plain don't **think** very well!"

Process skills offer both special and regular educators a common language for communication and for making instructional decisions more effectively. Indeed, the skills can be said to amplify both IEP development and the rational means-end model. The relation of the process skills to IEP development and the rational means-end model is shown in Table III-1.

Under the headings shown above. Chief among these dimensions are interagency, interdisciplinary, and interprofessional cooperation, and the human processes and communication essential to the overall work of preparing personnel for special education.

To describe how process skills can be used effectively in regular classrooms for the solution of many different kinds of problems, Schenkat and Battaglini developed a reaction paper, "Process Skills in the Classroom" (Schenkat & Battaglini, 1979, see Appendix A) which they first distributed to the education faculty and then discussed at a monthly inservice meeting. The science educator dramatized the theme of the paper by demonstrating how he, with no experience whatsoever in special education or spelling instruction, could use process skills to diagnose the specific deficiencies of a student with spelling difficulties. The demonstration kindled faculty interest in the direct application of thinking skills, and the interest remained high throughout the winter term of 1979-80. Subsequently, the faculty members requested a one-week joint summer study session to review process skills and their applications to teacher education and teacher decision making.

During the winter of 1979-80, the project director produced another paper for faculty discussion. Directed to students, it clarified for them the distinction between acquiring knowledge and using process skills, two proficiencies that are essential to academic success. The paper, "Blooming Freshmen" (see Appendix B), introduced students to Bloom's Taxonomy of Cognitive Development (Bloom, 1956). Ultimately, the paper was made a unit in the freshman level Educational Foundations course.

The science education specialist designed several procedures to instruct faculty members in the use of process skills for inductive problem solving. In addition, he related deductive reasoning to the stereotyping that is often done as a result of insufficient familiarity with handicapping conditions, hidden assumptions teachers sometimes make, and invalid syllogisms that may guide teacher behaviors. As a result of the workshops on process skills and their applications to teacher education and teacher decision making, a training manual, "Applying Critical Thinking Skills in Preservice Teacher Education Classes" (see Appendix C), was prepared.

Faculty members attending the workshop worked through the training manual on the application of process skills in teacher education. As a result, they began to treat the development of course syllabi differently and to develop a new series of student-expected outcomes that called upon the demonstration of process skills. Some examples follow:

Educational Psychology:

Describe at least three practical ways for a classroom teacher to systematically gather data on operationally defined student behavior.

Describe the parallel between an "operational definition" (Unified Science) and the behavior.

Reading Methods:

Name the types of errors to note while a pupil is taking the reading inventory test.

Discuss possible inferences that may be formed from the observed data.

Identify an inference and design a hypothesis and a means of testing it.

Language Arts and Social Studies:

Outline the use of the process skills to determine the skill weaknesses in the area of sound-symbol reproduction.

A measure to assess the critical thinking skills of education students was also developed

by the science educator and the project director. It starts with considering the nature of mildly handicapped students' learning and behavior problems and goes on to the steps a teacher might take to solve them. The steps are based on sections of the Watson-Glaser (1964) Critical Reasoning Test (inferencing, hidden assumptions, deductive reasoning, interpretation, and evaluation) which seem to be critical dimensions of problem solutions. The derived assessment instrument ("Assessment of Critical Thinking in Education Majors," Appendix D), contains the following three subsections:

I. Reliability — interpreting reliability, inferencing, testing inferences, and generating and testing valid inferences.
II. Validity, deduction, hidden assumptions.
III. Synthesis — generating hypotheses and drawing conclusions.

The following items are representative of the test content.

Test Sample

Assume the following information is true:

Jane has been assigned to a fourth-grade class of lower IQ children. Her former teacher has stated that Jane is usually inattentive. You have also discovered that Jane is from an unstable family unit. In today's lesson you have presented a new concept to Jane's class and have given a seatwork exercise to test their comprehension of your instruction. The exercise has 20 items: 7 representing the new concept and 13 items relating to the prerequisite concepts (taught earlier). Most of the time Jane was attentive during the exercise. After grading the exercise you note that Jane achieved 0/7 correct responses on the new concept and 12/13 requisite concepts correct.

A The following inferences have been offered as explanations for Jane's performance. You are to rate each inference as either true, probably true, insufficient data, probably false, or false, using the criteria for each category as they are stated in Part I of this test.

Inferences

1. Jane's prerequisite skills are adequate.
2. Jane was inattentive during the exercise.
3. Jane was not motivated to do well during the exercise.
4. The instruction was presented poorly.
5. Jane has a lower-than-normal IQ.
6. Jane did poorly on the new concept due to being disturbed by family problems.
7. Jane copied someone else's paper.
8. Jane scored poorly on the new concept because of her IQ.

B. Suppose you desired to test inference #8. A reasonable hypothesis might be as follows:
"If Jane did poorly on this test due to her lower IQ, then other children with similar IQs should show similar results."
Given that the IQ scores could be obtained the exercise results could occur in one of the following two ways:
Observation 1. Children with similar IQs showed similar results, or
Observation 2. Children with similar IQs showed different results.

9. What could you validly conclude with observation #1?
10. What could you validly conclude with observation #2?

C. Suppose you desired to test inference #7. Create a reasonable hypothesis in an if-then format.

11. "If_____
then _____."
12. Write observational test results (as exemplified in section B) and determine what could be validly concluded from each alternative test result (as exemplified in items #9, #10.)

The focus on process skills and its follow-up illustrated two important conditions: (a) local personnel and other resources at most institutions go untapped and (b) college and university administrators simply do not recognize the number of hours that are needed to obtain quality programming in teacher education. In fact, most of the progress achieved by PRISE was more the result of the summer workshop time bought with project funds than of the monthly workshops. No matter how committed to a goal the members of a faculty may be, there are limits to what they can accomplish during the regular academic year. The time limitations also may prevent faculty members from crossing departmental lines to explore possible resources or to serve in such a capacity.

TEACHERS' REASONING SKILLS: RESEARCH FINDINGS

The teacher-education model developed at the College of Saint Teresa focuses on reasoning skills. It stresses not only teachers' knowing process skills in order to teach them to children but, also, using the skills themselves to solve problems and to make decisions. Like the Unified Science model (Chapter 2) it is replicable.

For over 30 years, teacher-training literature has characterized teachers broadly as clinical information processors, decision makers, diagnosticians, and problem solvers who direct their skills to helping children to learn. In order to do so, the teachers are expected to specify objectives, select learning activities, organize learning activities, and develop evaluation procedures. Taba (1962) considered curriculum planning to require orderly and careful thinking; she recommended the use of the means-end model because of its rational and scientific methodology for carrying out the task. The critical nature of decision making in the classroom was stressed by Hunter in her statement that teaching is "a process of deliberate decision making and action that makes learning more probable and more predictably successful than it would be without teaching" (cited in Cummings, 1980, p. 1). Unfortunately, very little research exists on the role of teachers as decision makers, and what research is available casts doubts on the use of the rational means-end model by teachers.

After reviewing the published literature on the subject, Clark and Yinger (1978) concluded that although curriculum planning "requires orderly and careful thinking," (p. 3), the published reports indicate that

> Teachers do not seem to follow the rational model that is often prescribed in teacher training and curriculum planning. In particular, the teachers studied neither began nor guided their planning in relation to clearly specified objectives or goals. Rather, teacher planning seems to begin with the content to be taught and considerations about the setting in which the teaching will take place. The focus shifts to student involvement, a process objective. The activity, rather than the objective, seems to be the unit of planning. (p. 38)

Observations in a sixth-grade classroom, led Woodlinger (1980) to conclude that many of the teacher's decisions were based on inferences about rather than direct evidence of students' cognitive or affective states; she seldom sought evidence to verify her inferences or feedback to validate her decisions.

Griffin (1983) reported on the essential planning and decision-making skills of beginning educators.

> [W]e are becoming certain that teacher planning and decision making are being abrogated by planning and decision making which takes place some distance, temporally and idealogically, from the classroom. This is particularly true for reading and mathematics in elementary schools but, given the enormous amount of time now devoted to those two curriculum areas, the conclusion would probably hold for the school day generally. (p 10)

At the preservice level, student teachers learn how to plan lessons but are relatively uninformed about how to plan for sequences of instruction. They receive little assistance in identifying available and appropriate data sources on which to base decisions for taking instruction beyond the initial outline. Thus, Griffin (1983) argued that student teachers make few curriculum decisions on their own and probably enter the work force with underdeveloped skills in planning and decision making.

The weight of evidence (e.g., Clark & Yinger, Griffin, Woodlinger) leans toward the conclusion that teachers do not use process skills. Thus, their ability to carry out classroom roles as clinical information processors and decision makers is seriously limited. More is at stake, however. Without process skills, teachers cannot deal with students' misconceptions. The latter have been the subject of extensive research over the past few years (Hewson & Hewson, 1983, and Osborne and Wittrock, 1983, esxpecially in science education.

Misconceptions indicate that an individual (e.g., student or teacher) holds ways of viewing the world that may have explanatory power but differ from the correct scientific interpretation. For example, a student may believe that

plants take in food from the soil in the form of water, minerals, and fertilizer rather than knowing that plants make their own food from sunlight through the process of photosynthesis. Misconceptions are extremely resistant to change. They call for teachers to exercise considerable skill in drawing analogies, making explanations, or giving demonstrations to counteract them. The problem is that the people holding the misconceptions build logical structures on faulty premises. It is not enough, consequently, merely to supply the correct information; the teacher must be able to use reasoning skills to find out what the fallacious premises are, get the student(s) to understand why the premises are fallacious, and then to help the student to rethink the subject under discussion from the correct premises.

Dealing with misconceptions starts with recognizing them. In order to do so, teachers must know what is the correct conception, which means having the necessary declarative knowledge. But then teachers must be able to build a transition from the realm of declarative knowledge to the realm of operative knowledge through process skills. For example of a learning model which can be used in teacher education to generate the movement from content to process skills, see Osborne and Wittrock (1983).

LEVELS OF CONCEPTUALIZATION AND TEACHING

In Chapter 2, the levels of dualism and relativism in Perry's Scheme of cognitive development were related to declarative and operative kinds of knowledge. The relation between operative knowledge and process skills was also shown. In this chapter, we demonstrate that learning the process skills is helpful not only in teaching science but, also, in providing a framework for teachers to think at a meta level about the entire teaching process. It was Arons (1983), recall, who described operative knowledge as the capacity to use, apply, transform, or recognize the relevance of declarative knowledge in new and unfamiliar situations. To conclude this chapter, one other set of relations is drawn—the close parallels between Perry's positions and the conceptual systems formulated by Harvey, Hunt, and Schroder (1961). The following summary of the systems is taken from Murphy and Brown (1970):

System 1. Teachers manifest unilateral dependence. They consider themselves, textbooks, and person in high positions to be the sources of authority, and what they say is "the highest good." Questions have only one "right" answer. It is inappropriate and unnecessary for students to search for other answers and thereby to defy authority. Teachers who function at this level deliver information and ask questions in such a way that only one answer is "right." Students are rewarded for recalling the definitions and facts provided by the authoritative sources and for conforming to the rules and procedures set forth by the teachers.

System 2. Teachers manifest negative independence. They "tend to reject the customary social roots for self-definition and esteem. They lack stable referents for their concepts which creates inconsistency and uncertainty in their functioning" (p. 531). In judging students' performances, teachers at level two tend to use criteria that are inconsistent, impulsive, or imposed erratically. They function like teachers at level one "except that they are erratic and unpredictable in their expectations of students." (p. 531).

System 3. The characteristic of teachers is conditional dependence, manifested by "high affiliative needs" and the susceptibility to influence by people or groups which they respect. "They are concerned with establishing friendships, intragroup concensus, and dependence relations but their dependence is based on mutuality rather than on authority and rules" (p. 531). They function at more abstract levels than the teachers at level 1 and 2 and "encourage pupils to express themselves and to theorize. They will not deliver [detailed] information and ask narrow questions as much...and will reward searching pupils and do less sanctioning of attainment and obedience to rules. However, they will sanction pupils, relations with others more than teachers functioning at other conceptual levels. They will also make more general supportive comments in the classroom" (p. 531).

System 4. Teachers are informationally interdependent. They "have abstract conceptual structures and are cognitively complex" (p.

531). They do not regard themselves as authority sources. Knowledge, to them, is tentative, not absolute, and they have respect for "doubt, an openness to new experience, and can consider situations from the pupil's point of view" (p. 531). Rules and standards are neither arbitrary nor imposed, rather, they are presented as information. Teachers at level 4 encourage students "to test, relate, and reflect upon their own ideas and to hypothesize, synthesize, and even conjecture about content. [They]...ask questions to aid in the search for understanding and for relationships rather than for precise, 'correct' answers. [They]...reward the seeking by pupils more than the finding of solutions" (p. 531).

It is apparent that System 1 teachers are at the dualist positions on the Perry scale and, thus, are able to convey only declarative knowledge. In order to transmit both declarative and operative knowledge, teachers must function at System 4, that is, must be at the relativist position on Perry's formulation.

Perry acknowledged the striking similarities between his model of intellectual and ethical development in the college years and Harvey, Hunt, and Schroder's (1961) model of conceptual systems and personality organization.

> In respect to the first half of our scheme, I wish to refer briefly to parallels in the work of Harvey, Hunt, and Schroder (1961). This work was contemporaneous with our study, and publication prior. For us, a major significance of the parallels derives from the fact that we were ignorant of the publication until after our own formulation was complete in 1960.... The confluence of these independent researches is to us a great encouragement. (Perry, 1970, p. 205).

By relating the two models to teacher education we can see the implications for the development of children's capacity to think critically. When teachers operate at the lower level (i.e., System 1 on the Harvey, Hunt, and Schroder scale), they control and limit students' cognitive functioning and, in fact, inhibit productive mental activity (Taba, 1967). Taba also found that

> ...children adopted irrational, unproductive, and arbitrary models of thinking in which they depended on memory and authority, rather than on judgment and inference. Dominative or authoritarian styles of teachers have been shown to result in less learning by pupils, more dependence on the teacher, more concreteness in pupil responses, and less cooperation and involvement in classroom activities while democratic or integrative teaching styles have been shown to produce greater achievement, more involvement, more abstractness in response, greater independence, and less anxiety (Anderson & Brewer, 1946; Harvey and others, 1966; Harvey and other, 1968). (p. 530)

After examining the results of studies of several thousand liberal arts students and several hundred preservice and inservice teachers, Harvey found that more teachers than liberal arts majors function at Level 1 conceptually and more inservice than preservice teachers function at this level (see Table III-2).

System 4 — the level of higher abstraction — in the Harvey conceptualization is compatible with Perry's concept of relativism. The ability to function at these levels is essential for teachers if they are to meet the current challenge of educating children to function in our changing economy. Yet, even during the 1960s when "sharper" minds were being attracted to teacher education, and when Harvey and his associates were carrying out their investigations, less then 5% of teachers were performing at this level. The statistics, indeed, suggest that some preservice teachers who are able to function at the operative knowledge level lower their performance to the declarative knowledge level (Table III-2), after entering the teaching force.

This discussion is not meant to disparage teachers (a too-frequently maligned species). The differences between education and liberal arts majors in both Harvey's studies and Renner's analysis of CST students (Table II-1) are not large at some levels, and Renner's findings suggest that some education majors have the capacity to raise their levels of conceptual functioning when they are exposed to instruction that is directed to operative thinking. Perry's scale research also shows that college

TABLE III-2

CONCEPTUAL LEVEL PERFORMANCE OF LIBERAL ARTS MAJOR AND TEACHERS

	1	2	3	4
Liberal arts majors	35%	15%	20%	7%
Preservice teachers	45%	5%	25%	5%*
Inservice teachers	55%	—	15%	4%

* Totals do not equal 100% because of some category overlap.
Source: O. J. Harvey. December 1970. Beliefs and behavior: Some implications for education. *Science Teacher,* 37:10-14.

students can and do raise their levels of conceptual functioning during their college careers if the environment supports such development.

CONCLUSIONS

An undertaking such as PRISE, the Dean's Grant project at CST, has a two-fold obligation. to the agency funding the project and to the institution in which the project is housed. Thus, to meet its obligations to the Bureau of Education for the Handicapped and, subsequently, the Office of Special Education, the activities of PRISE focused on reconceptualizing teacher education at CST so that all graduates would be prepared to provide instruction to children with diverse learning needs within the same classroom. In the process, the teacher-education program was reconceptualized as a whole, that is, all courses were interrelated as part of one curriculum, duplicated and overlapping course content were eliminated, leaving more time for infusing special content where necessary and/or providing more time for teaching and learning, and courses were directed to student outcomes, that is, to the attainment by students of those learnings and methods which would enhance their professionalism and their ability to help children learn.

To fulfill its obligation to the College of Saint Teresa, PRISE accepted the premise that because CST is in the business of training teachers, it is incumbent upon all Education Department enterprises to aim for excellence. Thus, PRISE went beyond concerns with the curriculum alone to concerns with those qualities that are characteristic of excellence in teachers. Initially, the relation was demonstrated between the science process skills, which form the central element of the Unified Science sequence, and classroom problem solving and decision making. Because education is a professional activity and, like all professions, has a growing body of knowledge which takes up more and more time in preparation programs, the project director helped to demonstrate the importance of liberal arts preparation to the training of professionals. Not only do teacher-education candidates benefit from this extended concept of who should learn to use and teach process skills, but, also, the college as a whole benefitted by the strong support it received in the development and organization of the Design for Choicemakers program.

The directions taken by PRISE were unique. The reason, of course, as manifested in other Dean's Grant projects, was the combination of influences from the institution in which the project was located, the people participating in the project activities who put their stamp on the means and ends of the activities, and the interaction of institutional and departmental receptivity to innovations. At the College of Saint Teresa, the latter was extraordinarily high.

CHAPTER 4

THE FOUNDATIONS OF EDUCATION: REASONING AND THE LIBERAL ARTS

We are generally the better persuaded by the reasons we discover ourselves than by those given to us by others.

Blaise Pascal (1623-62)

The reasoning skills needed by teachers to teach science are described in Chapter 2 and to serve as the foundation for solving classroom problems, in Chapter 3. Problem solving in education differs only slightly from the problem-solving models found in business, social work, nursing, and,indeed, most professions. The reason is that all are based, for practical purposes, on the rational means-end model. We know that most professional accrediting agencies call for reasoning and problem-solving skills yet few graduates of baccalaureate programs seem to have acquired them. Who or what is at fault? The answer, from our perspective, is the emphasis on declarative knowledge to the exclusion of the joint importance of declarative and operative knowledge.

We contend that the starting point for improvement in teacher education or, for that matter, any profession, should be a strong foundation in liberal arts. That is where students can be exposed to and can acquire highly integrated processing systems. No professional training unit has the time to teach students the basic skills making up such systems; indeed, many professional schools and departments are hard-pressed now for the time they need to train highly proficient graduates. Certainly, professional programs will be able to turn out better practitioners if all their candidates already have acquired reasoning and problem-solving skills; these skills are so basic to all of education that professional units should not be expected to teach them. The responsibility for developing these critical skills must rest with the liberal arts.

At the College of Saint Teresa, the opportunity to revise the liberal arts curriculum to include the development of critical reasoning skills in students was the serendipitous result of the new Unified Science sequence interacting with the evolution of PRISE, the Dean's Grant project, and their combined influence on the organization of the "Design for Choicemakers" program. That program, consequently, is the focus of this chapter.

DESIGN FOR CHOICEMAKERS

The expanding nature of this liberal arts program over the six years of its existence, so far, has provided a wealth of information to document its activities and achievements. The **Operations Manual** (College of St. Teresa, 1983) offers a comprehensive picture of the program, hence the discussion here is limited to the contributions of the revised liberal arts curriculum at CST to the development of all professions and, especially, that of teacher education. To provide the essential background, there are described briefly in this chapter the following:

- Beginnings of the "Design for Choicemakers" program
- Origins of the Desirable Characteristics of a CST Graduate
- Features of the program
  - — Introduction to Liberal Studies
  - — Required courses
  - — Core courses
  - — Senior seminar
  - — Faculty development
- Program evaluation

The Beginnings

Starting a comprehensive program like "Design for Choicemakers" requires a conscious decision, dedication, money to pay for extras, and time. At the College of Saint Teresa, the development of the program took six years; the effectuation of its components, however, is an on-going endeavor.

The stimulus for the program came from the Sponsorship Statement issued by the Rochester (Minnesota) Franciscans in 1973. It was a contemporary expression of the Order's phi-

losophy of education. In order to implement the Statement, an examination of CST's purposes, goals, and capabilities was the essential first step to make sure that whatever program was conceived would be intrinsic to the College. In 1974, therefore, a committee of faculty members, administrators, and students was organized to prepare a statement describing the beliefs and commitments of CST. After two years of work, the committee produced "The Mission and Identity of the College of Saint Teresa" with the cooperation of other members of the college community who had a special interest in this statement. While the committee was engaged in its deliberations, the Academic Affairs Office submitted a proposal for financial aid to the Northwest Area Foundation; the proposal was accepted and in 1978 CST was awarded the first of three grants totaling $250,000 over a 6-year period. The Council of Independent Colleges' Project QUE awarded additional funds to CST which enabled the college to bring various nationally prominent authorities on college development to the campus.

Desirable Characteristics of a CST Graduate

Once a college makes the decision to begin a comprehensive program like the Design for Choicemakers, it is necessary to clarify for faculty members, staff, and students the qualities and goals the endeavor seeks to produce. Hence, the project staff initially researched theoretical models on adolescent and young adult development, such as models by Douglas Heath, Piaget, Kohlberg, and Perry. In addition, the historical goals of a liberal education were explored for outcomes with current relevance.

A series of meetings was held with groups of students, faculty members, and alumni who worked to reach consensus on the characteristics of a liberally educated person. From these lists, the desirable characteristics of a CST graduate were gradually worked out. Consensus on these characteristics did not come easily; it evolved over a three-year period. One validation of the selection is that they stand the test of time, that is, they correspond to the desirable characteristics of a liberally educated person compiled by Cardinal Newman in 1852 (see "Blooming Freshmen," Appendix B) as well as to the conclusions of recent research. Winston, Miller, and Prince (1979), for example, do not list individual characteristics but suggest them in their definition of personal development: the attainment of Autonomy, the establishment of Mature Interpersonal Relations, and the setting of Purposes and Goals. The list of desirable characteristics which has become the description of as well as the goals for CST graduates is as follows:

A. Critical Thinking
The student, with the assistance of the College community is enabled to
1. reason analytically
2. engage in reflective thinking
3. synthesize a point of view, formulating arguments to support it
4. evaluate and choose among alternative courses of action
5. apply abstract concepts to concrete experiences
6. apply knowledge from an undergraduate major field

B. Aesthetic/Cultural Development
The student, with the assistance of the College community, is enabled to
1. acknowledge the presence of mystery in life
2. demonstrate an understanding of the major forms of artistic expression
3. appreciate and participate in a variety of cultural/artistic experiences
4. convey meaning through creative and artistic experiences

C. Communication
The student, with the assistance of the College community, is enabled to
1. use various forms of writing competently
2. use effective oral communication
3. receive and interpret information effectively
4. use quantitative tools effectively

D. Breadth of Perspective
The student, with the assistance of the College community, is enabled to
1. demonstrate a familiarity with the ways of knowing in basic academic disciplines: arts, humanities, sciences, social sciences
2. interpret current problems within historical, cultural, political, global, philosophical, and spiritual perspectives

3. demonstrate an understanding of one's religious, faith heritage
4. understand the value systems operative in contemporary society
5. develop an ability to live meaningfully in a technological society

E. Autonomy
The student, with the assistance of the College community, is enabled to
1. develop a healthy self-concept including an awareness of one's sexuality, potentials and limitations, values and beliefs
2. act out of one's self-awareness to complete personal goals and planned activities
3. recognize and accept interdependence as integral to becoming autonomous
4. respond personally to God's revealing of Self in one's life

F. Social Relationships
The student, with the assistance of the College community, is enabled to
1. appreciate human diversity and respect creeds, value systems, and related actions of others
2. demonstrate effective interaction with individuals in a variety of settings
3. develop and remain faithful to commitments and relationships
4. move toward the achievement of a common goal by maintaining group support and cooperation
5. demonstrate responsible citizenship

G. Life Goals
The student, with the assistance of the College community, is enabled to
1. develop an appreciation of the importance of lifelong learning
2. formulate appropriate educational goals
3. select and activate specific career goals
4. acquire the attitudes, knowledge and skills to practice lifelong habits of healthful living
5. apply one's values to important life decisions (College of Saint Teresa, 1983)

It is important to understand that these desirable characteristics are not esoteric; they were formulated and set as practical goals for all students to strive for and attain. Hence, the characteristics are held to be the outcomes for all courses offered at CST and for the four-year learning experiences of all students. The notion of outcomes is addressed in some detail as the program features are described.

Specific Features

Introduction to Liberal Studies. This first-year required course is the key to the program as a whole. It was designed to give freshmen an overview of the expectations held for them by the college and of the experiences facing them. The content of the course introduces new students to the concepts of total student development and the means for achieving integration of the various facets of that development: critical reasoning skills, modes of knowing, values clarification, and creative life planning. The course is team taught by members of the faculty and staff members of the Student Affairs Division. Two views of the course are presented by instructors, one the science education specialist and the other an English professor (see appendices). Their papers show how the goals and purposes of the course apply to different disciplines.

The science educator's paper, "Strategies for Heightening Students' Reasoning Skills" (Appendix E), describes the initial efforts by course instructors to increase the students' capacities to reason beyond the dualistic position (on Perry's Developmental Chart). These early efforts engendered considerable hostility toward the instructors as well as the course, perhaps because the instructors were trying to use traditional textbooks to encourage the development of new ways of thinking.

When the instructor used some strategies from cognitive psychology and science education, the students were then able to open their minds to new ways of thinking about ideas and problems. Subsequently, the instructors adopted the language of Toulmin (Appendix G) and his associates to provide a common medium for discussions of reasoning and for introducing students to relativistic thinking (Toulmin, Rieke, Janik, 1979).

In Appendix F, the English Professor, who also participated in team teaching the Introduction to Liberal Studies, addresses the problems and solutions from his particular point of view. His paper, "Critical Reasoning and College Writing Programs: A Case History and a Modest Proposal," examines the implications of the course for writing (English) programs that have the new stress on critical thinking;

the actual impact of the new development at CST, as exemplified by the freshman course, upon writing instruction at the college; and possible and desirable developments in the future to enhance present goals and curricular expectations. A critic of the textbooks that were first used in the course to encourage critical thinking, he also found a solution in the constructs of Toulmin et al. His description of how these constructs are used reveals their communicative power and their potential for moving students toward relativistic thinking.

Core Courses. At the heart of the liberal studies program at CST is a group of 121 core courses. Each student is required to select 12 as the core of her program. The courses are unique in that the outcomes of each are designed to enhance related desirable characteristics. Thus, faculty members are responsible for producing course-relevant desirable characteristics outcomes which are considered to be as important as the particular course content. Core courses are reviewed by the Curriculm Committee and accepted only if they meet the design requirements of the desirable characteristics. Furthermore, the requirements for the core courses and their outcomes have resulted in the urgent need for faculty development inservice to enable instructors to write course syllabi that are outcomes related.

Senior Seminar. The Introduction to Liberal Studies prepares new students for the educational experience at CST. The Senior Seminar gives students the opportunity to summarize or synthesize their college experiences during their final year. Its purpose is indeed to integrate and synthesize what the student has learned in courses, from instructors, out of books, from peers, from self-examination, and from encounters with people outside the campus. The seminar is required and interdisciplinary in nature. It brings together students from the different specialty areas into small classes to work on issues that require both a variety of specialized bodies of knowledge and general intellectual competence. The goal is to orient students toward development beyond their tenure at the college. A major facet of the course is encouraging students to summarize their CST experience in terms of the future and continued development.

FACULTY DEVELOPMENT

When new members are sought for CST considerable weight is given to training in student development concepts and to the recognition of the instructor's role as much more than conveyors of knowledge. Because of the newness of this orientation, individuals with such training are not readily available; thus the college has made a significant commitment to the formal orientation of new faculty members during their first years. For such individuals, the **Operations Manual** provides the overall theme of the "Design for Choicemakers" program. Three full days of workshops are held prior to the opening of the school year; during the academic year, new faculty members meet for one-and-one-half-hour seminars on alternate weeks. The materials presented in these seminars include presentations on and discussions of such topics as evaluations of student learning, learning styles, and the developmental portfolios.

As a matter of fact, faculty development is an on-going inservice activity. For example, leaders in the student development movement (e.g., Douglas Heath, Lee Knefelkemp, William Bergquist, Richard Morrill, Jerry Goff) have appeared before faculty groups to discuss their work and ideas in student development.

Institutionalization

Currently, the "Design of Choicemakers" program is being extended beyond required and core courses to insure the use and development of desirable characteristics in the professional majors offered at the College of Saint Teresa. The Academic Dean has requested that within a three-year period all academic majors have a mapped delineation of the interplay of courses within the major and how they apply to the enhancement of the Desirable Characteristics. Thus, although the grant funding has terminated, the continuation of developmental education at CST is assured because it is being institutionalized at all levels.

Formal Evaluation

Because the program at CST is outcomes based, evaluation is an important consideration. So far, no commercial instrument is available for the task. It was incumbent upon faculty members, consequently, to compen-

sate for the deficiency. Thus, a group devised an instrument in two forms which is used to assess the attainment of the Desirable Characteristics. This instrument is based on the constructs of the American College Testing Program's College Outcomes Measurement Project, which also addresses the assessment of the general function of liberal education. The CST instrument is composed of several cases, each with a set of related assessment items. The cases tend to be descriptive of current and future issues in particular settings. For each case, the assessment items are related to a subset of the Desirable Characteristics that span several categories.

The measure was first administered to all incoming freshmen and graduating seniors in the fall of 1983 and spring, 1984, respectively. Preliminary results showed significant differences between freshman and senior years. These data are not longitudinal. In the future, however, comparisons across time for the same populations will be possible.

In thinking about the broad outcomes in the "Design for Choicemakers" program and their institutionalization at CST, it is evident that no one instrument can serve as a total outcomes measure. For example, to evaluate a student's total development, a comprehensive instrument might account for only about half of the student's development. Another third or so of the student's growth probably could be evaluated by performance in the curriculm and co-curricular offerings. Dependence on course-specific evaluation, consequently, has demanded that faculty members become proficient in evaluation. The balance of a possible program assessment would be taken care of by student self-evaluation. The college has expended a great deal of effort in encouraging the development of student portfolio/developmental transcripts. Portfolios give students the opportunity to become aware of their growth in self-directed, holistic, and integrated learning. The student's records of personal growth experiences are also an exercise in self-awareness.

The developmental portfolio, basically, is a log of the students' learning experiences through either curricular or co-curricular activities. Keeping the log, quarter by quarter, is a consciousness-raising acitivity; it enables students, to integrate their entire educational experience at CST.

We want to emphasize here that "Design for Choicemakers" is not a static program. As institutionalization proceeds, there is a continuing sense that changes have occurred and are occurring within the program and that there is openness to new developments.

The following analysis, taken from the **Operations Manual** (CST, June 1, 1983, pp. 2-3) demonstrates this awareness.

As we move to institutionalize the program, retrospection allows us to see in it the purposeful, intentional changes that have enabled us to succeed. We have moved

—from	content-based academic programs	to	academics in the context of total student development
—from	college as groups of students, faculty, staff, administrators	to	college as community of learners
—from	faculty operating within disciplinary specialties	to	faculty with expanded interdisciplinary and generalized expertise
—from	provision of extracurricular activities	to	intentional co-curricular involvement
—from	religious and philosophical classroom instruction related to values	to	a spiritual and integrated valuing process in many contents
—from	institutional tendencies to area self-sufficiency	to	institutional networking and sharing

A paradigm shift "from basically masculine organizational and teaching styles to a style that integrates masculine and feminine approaches in a fully human educational model" also has occurred. The manual is quoted again:

We have moved from a program that stressed:

— logical analysis;
— discreteness;
— knowledge for its own sake;
— self-sufficiency; and
— intellectuality;

to one that explicitly nurtures integration of:

- logical reasoning and intuition;
- analysis and synthesis;
- knowledge for its own sake and for the sake of service;
- self-reliance and interdependency;
- intellectuality and the emotional, moral, social, interpersonal, spiritual, and physical aspects of a human being.

* * *

To this point the chapter has given a history of how the "Design for Choicemakers" program evolved at CST and described some of its significant features and on-going operations. The entire program is more adequately described in the **Operations Manual*** (CST, June 1, 1983).

HOW TEACHER EDUCATION CAN LEAD CAMPUSES TO A STUDENT DEVELOPMENT MODEL

The CST experiences are a description of a total institutional response to student development. When comparable interests fail to appear on a campus, committed individuals may be able to stimulate sufficient interest in student development to create a following and, subsequently, the conditions for adoption. If the committed individuals are members or associates of the Department of Education, they may be able to use their knowledge of students' needs and the potentials of different kinds of instruction to build a broad base for the acceptance of student development concepts. At the College of Saint Teresa, the Dean's Grant Director became such a catalyst. During the final three years of PRISE, he worked with faculty members outside the Education Department to create a committed cadre.

The first three years of PRISE, in general, focused on developing reasoning skills in teacher-education majors so they could use these skills for instructional and remedial purposes and, especially, for the solution of classroom problems. By the beginning of the fourth year, it became apparent that the place to help students to acquire the skills was in liberal arts. Thus, the director began to focus the project's orientation toward the development of reasoning skills in all college graduates. The Perry model and its derivatives were seen as the most cogent means of conveying the project's orientation. The activities undertaken on the CST campus, consequently, led to the growth of a body of learning which can be replicated on other campuses. The following suggestions are offered with the qualification that they worked in the context of total student development which was put in place at the College of St. Teresa.

Following his usual practice in initiating project activities, the project director developed a position paper, "Help Wanted, Liberally Educated Teachers" (much of the source material came from a special issue, "The Liberal Education of Educators," of the **Journal of Teacher Education)** which he distributed to the target group of faculty members, in this case, the liberal arts faculty. The purpose of the paper was to clarify for them the importance of their contributions to teacher education. However, because it seemed much more important to introduce the concepts of student development to the liberal arts faculty and to show clearly the relation of student development to whatever academic or professional major—including teacher education—CST students select, the initial purpose of the paper was de-emphasized. To attract faculty members, two dinner meetings were sponsored by PRISE during the winter term of 1982-83 at which an overview of the Perry model was presented and discussed in terms of its purposes and application.

More than half the faculty attended the meetings. The subsequent evaluations indicated considerable enthusiasm for the model and a high degree of interest in what was perceived to be utility for CST. When the participants at these meetings were polled on whether they wanted to learn more about Perry's concepts and their effectiveness in classrooms, the participants expressed some interest in attending informal get-togethers for that purpose. As in most colleges, however, finding a time when everyone who is interested in a voluntary activity is free was difficult; finally a varied schedule of noon, late afternoon, and evening meetings was agreed upon which gave all faculty members opportunities to participate. The only request made was that if people found themselves unable to

*For copies of the manual, write to the Dean for Academic Affairs, The College of Saint Teresa, Winona, MN 55987.

attend, they would notify the academic affairs office by 11:00 a.m. so that the arrangements for refreshments could be adjusted.

Given the high level of interest expressed in exploring Perry's work and the high degree of flexibility built into the schedule of meetings, it was anticipated that participation would be high. The project director was disappointed, consequently, when only a few individuals showed up at the sessions.

Over 75 articles* citing research on the Perry Scheme across disciplines were collected in a central place for faculty members with an indexed bibliography and provisions for photo copying. Little use was made of the opportunity to gain written information on the scheme.

This information on lack of participation is not reported as criticism of CST faculty members but to acknowledge that the personnel at institutions of higher learning are incredibly busy people and pulled in many directions by the demands of different people and obligations. One response to the initial poll is illustrative: "I am interested if there isn't too much of a time commitment because my spring quarter is really packed!" In order to bring faculty members together for developmental activities, then, careful preplanning and scheduling are essential as well as administrative encouragement of participation in the activity.

A small cadre of CST faculty members was rallied to work on the Perry model as an experimental endeavor in the fall of 1983. This group, which dubbed itself "The Perry Pioneers," had begun meeting initially to acquire more information on student learning and its applications. In trying to formulate a purpose for continuing the meetings over the fall and winter quarters, the project director quickly discovered that a series of meetings could be held just to discuss what the outcomes of the meetings should be! Hence, he took the initiative to draw up the following suggested plan to engage the participants and their general expectations.

*A bibliography is updated semi-annually with all Perry research citations—the number is over 300 currently—by the Institute for Studies in Educational Mathematics ISEM, 10429 Barnes Way, St. Paul, MN 55075. Most articles are available through ISEM at 7¢ per page. In addition $10 per year supports membership in the Perry Network and provides the member with the updated bibliography and a newsletter from ISEM.

Suggested Plan for Perry's Pioneers

Questions to answer:

1. Does the King (1982) measure (Reflective Judgment Scale) reflect growth over a quarter?
2. Can we devise a questionnaire that reflects growth?
3. Can students articulate aspects of growth?
4. Do students relate content across courses?
5. From a student's perspective, can we identify effective practices?

Steps:

1. _____ Develop a questionnaire related to students' conceptions of: knowledge, learner and professor roles, evaluation, cognitive skills, and role of peers in learning.
2. _____ Conduct practice interviews, critiques, and refine. (two hours)
3. _____ Between September 26 and November 1 schedule four hours of seminars on challenge and support variables in student development.
4. _____ Select participating education students, based on winter quarter course enrollment, to administer Reflective Judgment Scale and locally developed instruments.
5. _____ Interview students on questionnaires, what Desirable Characteristics are in place? (four hours)
6. _____ Learn two courses in terms of information, concepts, intellectual skills, auxiliary skills required. (eight hours) Instructors given four hours to explain and be available for clarification.
7. _____ Visit each class twice to generate a source of interview questions. (four hours)
8. _____ Have four follow-up visits with students (average 1.5 hours) to get insights on questions 3-5. (six hours)
9. _____ Summarize insights into agreed-upon format. (eight hours)
10. _____ Participate in all-day wrap-up in mid-March. What did we learn? What recommendations can we make? (eight hours)

* * *

The plan contained some concrete suggestions for the faculty members to react to and to decide what they wanted to do over the two terms. The structure of the project intentionally placed the participants in a very active learning role as opposed to staying detached and passive, the posture when learning from an expert. (The latter characterizes the dualistic level in the Perry Model at which information conveyed by "experts" is accepted as the only truth.) It is interesting that academicians who have been conditioned to inservice presented by outside experts are very reluctant to trust their abilities alone or in teams to use literature reviews as the bases for solving problems. A very important change took place in the members of this group with time, however; they moved from thinking that they needed the advice of experts to realizing their own ability to use the structures of the models to learn about students.

After the group accepted the suggested plan, the development of a questionnaire or interview format to administer to students was begun. There was common agreement that it was essential to go beyond just looking at students in Perry's broadly delineated positions of dualism/multiplicity/relativism/commitment to relativism; what was actually needed as a focus was the implications of these different levels of conceptualization for learning. This idea had been well set out by Knefelkamp and Cornfield (see "Blooming Freshmen," Appendix B, Chart 1). For each Perry position they posited a student's conception of knowledge, learner, professor and peer roles in the learning process; evaluation; and cognitive skills.

With this general framework the group began to think about questions to ask students. The project director developed a 30-item instrument that was representative of the positions and conceptions. Students were asked to respond true or false and to defend their choices on such statements as, "When two authorities differ, one is wrong." "I react strongly against fuzziness, for instance, teachers who don't always give clear explanations or direct answers." and "A primary concern in a new class is figuring out what to learn." Between the first and second sessions, the project director administered the instrument to three students and then transcribed their responses. The transcriptions were distributed to group members at the second session so the could try their hands at rating the responses.

At this point faculty wisdom suggested that perhaps the instrument overcomplicated issues and the desired information could be obtained by simply asking students some direct open-ended questions. The group then devised nine questions based on the Knefelkamp and Cornfield ideas; they turned out to work extremely well. The questions follow:

1. What was your favorite subject in high school? Why?
2. Who was your favorite teacher in high school? Why?
3. What do you see as the main task of a teacher? Explain.
4. What do you see as the main task of a student? Explain.
5. Describe some of the intellectual tasks of students that you think are most essential in a college program.
6. What role do you think your peers play in (the) your learning process?
7. How do you see evaluation as applied to your learning? Defend your stance.
8. What are some of the challenges to learning that you have experienced in various classes, thus far? Describe those challenges.
9. What are some of the sources of support that you experience in your learning? Describe these factors that contribute to your being supported.

As soon as the group felt confident about what to ask students in interviews, arrangements had to be made to select students. Even in a small college, this is no easy task because students had to be enrolled in a select group of courses: those core or education courses designed around the characteristics of a liberally educated person which instructors would permit their peers to audit. Furthermore, both student and faculty member interviewer had to have compatible schedules.

Following the selection of eight potential participants, meetings were held with the students individually to explain and secure their approval for allowing faculty members to engage in this learning project. It was impor-

tant to stress to the eight students that they would be helping a group of faculty members to become more proficient in facilitating student learning. Project funds allowed paying students at work-study rates for participation (students earned between $15 and $20 for their meetings with faculty members during the winter quarter).

A great deal of specificity is needed to work with faculty members on such a project — setting out expectations, time lines, meeting times, making secretarial arrangements — so there is little confusion. Thus, the project director spent considerable time just working out the logistics of the endeavor. The following seven steps, which were detailed by the project director, were needed to complete the interview project:

1. Contact your student for an initial interview. It would be best to have this completed at the latest by January 6, 1984. In giving the interview based on the nine questions, I found students had difficulty, particularly with the questions on evaluation, challenge, and support. You might want to keep that in mind and to feel free to reword the questions if students have difficulty in answering them as asked.

I will get blank cassette tapes to you and have the tapes transcribed, if you decide to tape the interview. Another option is to have students write responses to the questions. I have mailed to the participating students the Reflective Judgment instrument developed by Pat King and have asked them to return it to me prior to leaving for Christmas vacation. I have enclosed a copy of the Reflective Judgment instrument if you care to study it.

2. Contact the instructor of the course to find out about the goals for the course. In reflecting on our nine questions to be used for student interviews, we may wish to ask the faculty similar types of questions: What do they see as the role of an instructor? What do they see as the role of the student as learner? How do they see peers in the learning process? etc.

Explain that you will give plenty of advance notice for the visit. Continue to reinforce as I have in the letter (enclosed), that the purpose is not to look at their teaching, but just to look at how students are integrating their experiences. Also, if instructors are interested in coming to our January 13 or any subsequent meetings, they are welcome.

3. Merge the information gained on students and courses into hypotheses about the student's match with the course for our discussion on January 13.

This discussion will be held in the room between the Curriculum Lab and Office, from 3:00 to 4:30 on that Friday afternoon.

In addition to giving support and suggestions to our colleagues at that meeting, it might also be appropriate to decide what type of information we wish to record and how we will keep track of the learnings from working with the students.

4. Visit each class twice and have a visit with the student following the class visit. It might be best to see both courses in the span of a couple of days so it will be possible to have only one instead of two visits with your student. Recall, students will be paid a work-study rate for their visits with you.

5. A meeting will be scheduled for late in January after the first sets of visits are completed to discuss the Project.

6. At the end of the quarter, interview your student again on the nine questions.

7. Meet at the end of the quarter to summarize the learnings from our collective effort and to discuss any future plans.

* * *

The faculty participants needed a lot of structure initially, almost as if they were at the dualism position on Perry's chart. The idea of developing their own instrument seemed somewhat foreign to them just as, subsequently, was the idea of discussing the concepts of student development without outside experts' advice. But by the time the project was over (end of the winter quarter), the group displayed a high degree of confidence in their own abilities. Furthermore, the members were greatly interested in what they had learned

and in the value of that learning. The group's commitment was solidified. Although project funding could not support additional activities, the group continued to meet and share their learnings and observations on working with students within the framework of the Perry constructs.

During the summer of 1984 the group was given the opportunity to plan a voluntary faculty workshop for 20 CST colleagues. It was pleasing to see individuals who, seven months earlier, had believed that they needed experts to tell them what to think about student development, now certain that they had learned a great deal on their own and could share what they had learned with peers. With funding from PRISE, the Perry Pioneers organized a workshop for colleagues that extended over two full days and further developed faculty instructional skills in fostering student development as set out in the Desirable Characteristics list.

In sum, the experience with Perry Pioneers led to several significant findings:

1. Good ideas alone do not capture people's interests and secure time commitments. One must understand the demands on dedicated faculty members and plan to provide resources or time to assure ample opportunity to engage in instructional development efforts.

2. Faculty members, when one moves into development efforts, have been somewhat conditioned to rely on an inservice model in which experts are brought in, even though they themselves may be expert enough to provide inservice in different institutions. By carefully structuring group activities over a period of time, these beliefs can be modified and faculty members can see the importance of joint effort in their own and other departmental areas.

3. Undertakings such as those described here take a high degree of attention to detail and coordination by individuals. The demands on time for coordination and planning cannot be ignored.

4. Finally, there is much knowledge in teacher education about pedagogy that has utility throughout an institution of higher education. It seems fitting in institutions without full-time instructional development offices that colleges of education provide these services.

The activities described in this section can be replicated on other campuses. The materials included in the appendices to this book and those that are available from CST can be adapted to local needs and even for other populations. For example, "Blooming Freshmen" (Appendix B) was written as a position paper for the faculty and students of the Education Department. When the Perry Pioneers read the paper, however, they saw its utility for all CST freshmen. The paper, they felt, offers a framework to conceptualize learning in keeping with the notion of helping students to develop highly integrated information processing systems.

In addition, the model discussed in "Blooming Freshmen" draws parallels between analysis and metacognitive skills which have received considerable attention in recent studies of comprehension. Essentially, Bloom's taxonomy, the model discussed in "Blooming Freshmen," provides a method for turning declarative teaching into operative learning.

CONCLUSION

Very few institutions are given the opportunity to establish a campus-wide student development program within a definite period of time. That the College of Saint Teresa was able to achieve this feat was due to the combination of several circumstances which made the program both acceptable and feasible.

One of the most important circumstances was the times. During the decade of the 1970s when CST began its push to the "Design for Choicemakers" program, grant money was available. The funding meant that CST could afford to use procedures and personnel services which would have been impossible otherwise. More important, perhaps, it could afford to experiment; if the possibility of one avenue dwindled to nothingness, people could go on to try a different one without jeopardizing the day-to-day operations of the college.

Then there were the two projects funded respectively by the National Science Foundation and the U.S. Department of Education, Office of Special Education. The NSF project—UPSTEP—brought the concern with the process skills—scientific reasoning—onto the campus in general and into CST Department

of Education in particular. Also, the science education specialist came to the campus to participate in the Unified Science sequence; subsequently, he helped to lay the firm foundation for the teaching of reasoning in the "Design for Choicemakers" program.

The second project, PRISE, acted as the bridge between the Unified Science sequence and its emphasis on process skills and the liberal arts courses where the latter skills were translated into an emphasis on reasoning skills and learning to learn. The project director's work with PRISE also enabled him to lead members of the liberal arts faculty into an understanding of and appreciation for the development of students according to the scheme developed by Perry (1970).

Another happy circumstance for CST was the Sponsorship Statement from the mother house of the College of Saint Teresa which urged the up-dating of the college's educational policies and led to the development of "a totally new understanding of the concepts of developmental education and student-centered education."

It is important to note, however, that the student development movement on campus might easily have dwindled to a happy memory when the last of the outside funds were spent. The fact that it didn't, and that institutionalization of the program began without any extra funding attests to the dedication of the college and its personnel to the new ideas. The strength of the program is also attested to by the establishment of outcomes for all courses in terms of the Desirable Characteristics for a CST Graduate. This list of characteristics is a unique feature of the college in Winona.

CHAPTER 5

MEETING THE CHALLENGE TO EDUCATION: AN INSTITUTIONAL RESPONSE

Change is not made without inconvenience, even from worse to better.

Hooker, cited by Samuel Johnson in the Preface to ***English Dictionary.***

In the preceding chapters we have tried to present a strong case for a development-based, liberal-arts-oriented, teacher-education program; it includes mutually agreed-upon outcomes that are built into the syllabi of courses, not only in the teacher-education program but, also, in the whole liberal arts curriculum. There is strong documentation of the need for this type of program. We also offer rational arguments for adopting the programs on other campuses. Most of the material in the appendixes are actual instructional packages for use by both faculty and students.

In this chapter, we take a look at the prospects of introducing needed changes in teacher-education programs throughout the country. At the College of Saint Teresa, the innovative efforts were grant dependent essentially; three major funding sources supported the projects to the extent of approximately $10,000 per faculty member.

The changes occurred at CST, however, mainly because faculty members were willing to operate in roles that went beyond the typical job description. For instance, a job description may call for the teaching of, say, eight courses per year and require attendance at departmental meetings and participation in college committees, but it does not call for extensive collaboration with peers within and across departments. At CST, the grant money bought the time for faculty members to work together summers to plan workshops or to give up a day or a half-day per month to work on project-related material. This is akin to the practices in public schools to develop staff members in curriculum and instruction by paying them on an hourly rate over and above the contract provisions or to provide substitute teacher days to make time for innovations.

Undertakings such as those at CST serve as model sites for how an innovative program can be accomplished. Publications, such as this book, can document situational facilitators as well as barriers to the innovation and become part of the collective body of knowledge on organizational change. It is assumed that people at forward-looking institutions will explore the possibilities of replicating the CST experience. It is also assumed that at some point the magic of the free market will influence students' preferences for institutions that incorporate forward-looking programs. Unfortunately, however, things do not work out exactly that way. (a) Good programs—even programs that are very good—seldom have a direct influence on the criteria students use to select colleges, and (b) hardly any institutions of higher education are able to command enough resource and development funds to pay faculty members for the time they spend in helping to bring about significant new modes of operations.

RELATIONS TO CORPORATE EXCELLENCE

The changes that occurred in the teacher-education program at CST, especially during the first three years of the project funding, were made possible by factors that parallel those responsible for the success of many American corporations (see Peters & Waterman, **In Search of Excellence**). These factors are as follows:

1. A bias for action.
2. Close to the customer.
3. Autonomy and entrepreneurship.
4. Productivity through people.
5. Hands-on, value driven.
6. Stick to the knitting.
7. Simple form, lean staff.
8. Simultaneous loose-tight properties. (p. 13-15)

Parallels can be drawn between these factors or characteristics and the operations of the Department of Education at CST under the Dean's Grant project. The characteristics also can

be juxtaposed to current operating conditions in schools, colleges, and departments of education at other institutions of higher education. The juxtaposition reveals an almost antithetical state between organizational characteristics of successful corporations and the current structures of education units.

At CST, "a bias for action" was demonstrated in the conduct of the project. A great deal was accomplished in three years through many faculty workshops and meetings and the collaborative efforts of faculty members. Perhaps grant timelines, which are often bemoaned by faculty members and administrators ("Project Director! You're trying to push us too fast! Don't you know change evolves?"), could collapse further. Typical teacher education units often move more slowly. For example, they relegate problems to committees that may study the theoretical nature of one problem for a year, just as a starter. Successful companies, however, if they take an analytical approach to decision making, are not made inactive by the process.

> A Digital Equipment corporation senior executive says, for example—when we've got a big problem here, we grab ten senior guys and stick them in a room for a week. They come up with an answer and implement it. (Peters & Waterman, 1982, p. 13)

Excellent companies have techniques to maintain this fleetness of operations. To what degree is quick action important in teacher-education units? What must change to create conditions in which unit managers will allow their staffs to work with fleetness? These questions a e central to teacher-education improvement.

The operations of the Education Department at CST was "close to the consumer" in that much of the redesign of the program was directed to maximizing teacher-education candidates' performances (e.g., using course audits, focusing on student-learner outcomes, adhering to a mastery model, and carefully interrelating course units). The external advisory committee of teachers and administrators that focused attention on K-12 schooling needs was another line to staying close to the consumer.

Currently, teacher-education facilities often distance themselves from their customers. At a campus level, the distancing occurs because of large lecture-type classes. At the K-12 school level, often it is only the lowest ranking faculty members or graduate students who supervise clinical and student-teaching experiences. In contrast, many innovative companies admittedly get their best product ideas by regularly and intently listening to the concerns of customers.

Staying close to the customer reflects a practice that is "values driven." In education, this would mean that the entire department has a common vision of what a good teacher should be and everyone contributes to realizing this vision. Project PRISE "stuck close to the knitting" of the Education Department because the "knitting" was to provide sound, regular education teacher preparation. Few add-ons were brought into the program at the time that Dean's Grants nationally were adding large quantities of content; rather, the delivery of instruction to students was refined and improved.

Research rather than "sticking" to the collective "knitting" of the unit is what is valued in many education programs. Indeed, college faculty members are reinforced to pursue individual professional interests, which often means narrow areas of academic specialization. There seems to be no common value base for faculty members and no common vision of what an institution's teachers should represent. Education management seems to be in a condition of anarchy because so much autonomy is vested in each faculty position, as if academic freedom had no other meaning.

Perhaps teacher education should be staffed by more teaching generalists who understand and can demonstrate good teaching and stay in touch with current practice. Faculty members need to go beyond intellectualizing and inculcating knowledge, they must be able to demonstrate performance. The research on coaching (Showers & Joyce, 1983) document this compelling need.

Significant research ventures might well be left to centers of collaboration by IHEs, state departments of education, and local education agencies. A premium should be placed on the application of significant research practices in both teacher-education units and school buildings, and experiences should be traded back and forth. Unfortunately, in many institutions, published reasearch, no matter how minor or impractical, is the only key to adminstratve recognition for promotion or salary increases. How much more efficient and productive it

would be if all research was considered to be departmental rather than individual undertakings, and local resources and expertise contributed to the work!

Project PRISE was strengthened by adhering to "productivity through people." In an era when Dean's Grant projects commonly patronized the mainstreaming speakers' bureau, PRISE helped to develop its own "experts." Workshops were conducted by faculty members who found the experiences job-enhancing. It is ironic that faculty members who often supplement their incomes by outside consulting are seldom asked to serve as consultants on their own campuses.

PRISE also reflected what in organizational parlance is called "simple form." That is, no hierarchy was established and individuals were not distanced from each other; instead, faculty members formed an integrated work team with a high degree of interdependence. The difficulty in achieving the latter has been referrred to under the characteristic "stick to the knitting." It is elaborated here in relation to the "course orientated" approach to teacher education.

Over time, courses take on an independent life; their relations to all other courses become obscured and regarded as administrative rather than programmatic. Each instructor tends to envision the course he/she teaches as an end in itself. In addition, each instructor tries to cover material which he/she considers essential for understanding key concepts that are interesting in themselves, indicative of the research and/or development in the area, and, perhaps useful for the student to know. Because course time is limited, more and more materials tend to be mentioned in passing or left for outside readings. Some instructors worry about whether it is more productive to expose students to a great deal of information which is not presented in depth or to the intensive study of central areas and key ideas.

Each instructor tends to hold students responsible only for the content covered in her/his course(s), which also simplifies the construction of tests. At the same time, the stress on courses rather than on a curricular body of knowledge seems to encourage students to regard each course as a discrete offering. For example, some proportion of students inevitably do not relate the theories of learning studied in educational psychology to the content of methods courses because they have no incentive to do so. However, if first-year students are aware that the content covered in, for example, the introductory psychology course will be directly drawn from in later courses, the relavence of the earlier material is thoroughly established. So, too, if instructors of first-year courses know that subsequent instructors will hold students accountable for previously learned material, the course content may be presented as part of the comprehensive curriculum and not as a separate area of knowledge. The focus of instruction must become how much students are able to master successfully rather than how much content can be crammed into alloted time periods.

Finally, Project PRISE supported "risk-taking." The impetus for the project, and the feature emphasized to the CST administration, was that the separate courses in learning disabilities could be eliminated and their content infused in the regular teacher-preparation sequences. This idea was palatable to the administration because it reduced the need for half of one faculty position. Although the infusion measure was acknowledged to be best for students it was also the most potentially problematic in dealing with state certification sections on the documentation of mainstreaming requirements. Another risk taken by PRISE was to focus on reasoning. As a rule, there is little in an institution's environment to support or encourage risk taking.

In organizational theory, the qualities found in excellent corporations reflect an open systems model in which a unit interacts with its environment's "input and output" ends to optimize the unit's function. Perhaps the environments surrounding teacher education are not in a sufficient state of flux to encourage this kind of interaction. Nevertheless, it is possible that many of the issues in teacher-education quality today can be related to the inability of the training organization to respond to the external environment.

The qualities of excellent corporations are in vogue today. However, the underlying wisdom that went into the generation of National Council on Accreditation of Teacher Education (NCATE) standards reflects a sense of the importance of corporate qualities. Standards call for a common vision in the design of curriculums. Faculty members are urged to stay close to the customer, and so on. Perhaps the frustration with standards that are meant

to improve organization practices arises from the organizational constraints on working to achieve the standards. The costly time-consuming NCATE process basically reflects this process when it functions at a superficial yet voluminous and masking level.

In the current movement for excellence in American education, schools, colleges and departments of education are realizing that organizational considerations may be shutting them out of the local school inservice market. Teacher-education units in the past have offered campus-based courses or MA-degree programs for individuals who sought to advance on school districts' salary schedules. Today, however, schools are seen as the focal point of change. Needs for improvement are seen as specific to the building with a high degree of collegiality necessary to bring about the changes. Knowledge inculcation, the traditional university role, has some part in improvement but coaching to permit the application of that knowledge, and modification of building conditions to allow the use of the knowledge, and so on, are also needed. The university expertise, consequently, is only a small part of the improvement equation. Furthermore, in the institutions of higher education's reward systems, a low value generally has been placed on inservice. Faculty members obviously need incentives to get them into the field and to provide the depth of clinical training that will be useful to a school. So forward-looking institutions are seeking this change; without it, districts will turn more and more to developing their own training capabilities or hiring consultants that are not associated with IHEs.

If the characteristics of excellence in successful corporations bear replication in education, then teacher-education units should be moving to acquire the organizational conditions that permit their adoption. B.O. Smith (1980) suggested that current funding dictates an academic rather than a clinical form of pedagogy, that is, the use of lectures rather than clinical instruction, student evaluations on normative rather than absolute standards, emphasis on faculty research rather than teaching and supervision, and eclectic curriculums based on faculty specializations rather than professional training emphases. If members of schools, colleges, and departments of education pursue modifications of funding conditions in today's higher education climate, strong allies will be needed to support the adoption of changes. Externally, many organizations and lobbying groups have important stakes in teacher-education improvement. Rallying the support of professional associations and parent and citizen organizations is paramount.

Internally, in institutions of higher education, teacher-education units seeking and receiving a higher level of resources would make their gains at the expense of other academic units. In situations of limited governance or shared governance in teacher-education units, it is unlikely that no matter how compelling the argument, low-status teacher education would not be funded. If one accepts the fundamental similarities of the characteristics of success in any profession—cognitive, interpersonal, and motivational skills (see Klemp, 1977, cited in "Blooming Freshmen," Appendix B—then the problems of quality preparation in teacher education are very similar to those in any other profession. Rather than pitting disciplines against each other in win-loss situations, perhaps it is time for broad reform efforts to benefit all contributors to undergraduate education. The following two suggestions may be useful:

1. Institutions of higher education need to shift focus from "course orientation" to student outcomes to prepare graduates to join the fellowship of educated citizens. CST's Desirable Characteristics list suggests some potential outcomes. Then it becomes the responsibility of faculty members to be cognizant of these outcomes and to develop courses around their attainment rather than to the attainment of narrowly defined knowledge accumulation.

Furthermore, educational institutions should be obligated to measure their success by their graduates' ability to perform in the workplace, which would reflect the attainment of the institution's desired outcomes. This goal places a significant demand on the total institution and on individual faculty skills to evaluate students in terms of the outcomes desired. The CST model of evaluation suggests that perhaps only 50% of a student's learning would be reflected in traditional paper-pencil measures.

2. Extensive faculty development programs should be conducted in all institutions of higher education to develop proficiencies in teaching to a student development orientation and to evaluating students for outcomes. At CST, the understanding of college student cognitive development (e.g., the Perry and other models) has been an enlightening and rewarding experience for many faculty members. It is not an overgeneralization to suggest that most college faculty members are frustrated in teaching undergraduates precisely because they have never thought in terms of students' levels of cognitive development or of the instructional implications. The research reports gathered by the Perry network is beginning to offer very concrete suggestions to college instructors to make their experiences with undergraduates richer and more rewarding.

The notions of coaching and collegiality—central to public school improvement—have great relevance in higher education. Although at CST faculty members attended large group presentations on the Perry model of student development and considered the presentations highly interesting and rewarding, it was the chance to work in small groups that supported and sustained growth in instructional processes.

In an organizational sense, conditions must be created to allow faculty members to work within and across disciplines to learn to use new skills. Some universities have instructional improvement programs. Where such programs do not exist, Hufker (1980) has found that teacher-education units can serve productively as leaders in faculty development efforts.

It is unlikely that the directions of future changes, given the increasing complexity of society, will allow higher education to stay only at the knowledge-dispensing level. At CST, the synthesizing of three disparate grants melded the college's instruction into a developmental program for preparing teachers to be both professionals and citizens in the 21st century. The need for other preparation programs to move in this direction is pressing. It stands to reason.

APPENDIX A

PROCESS SKILLS IN THE CLASSROOM

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COLLEGE OF SAINT TERESA

During the first year of PRISE, the project director realized, while auditing the courses in the Unified Science sequence, that a close parallel exists between the thinking underlying the scientific method and that leading to the development of special education methodology. Other educators also have remarked on the use of the scientific method in special education research and development. For example, Haring (1977) wrote,

> Special education has in the last dozen or so years become the one component of the overall educational system that relies most heavily on the scientific method and experimental research to improve instruction and to provide ways to change developmental learning and behavior problems. Basic research and application in learning, instruction, social reinforcement, behavior modification, curriculum analysis, and sequencing, have evolved from attempts to find the best methods of teaching handicapped persons. (p. 8)

In fact, whether it is so recognized or not, the scientific method can be a basic tool in the practice of all education. For example, it is the method by which the need for and provisions of IEPs can be determined and it is the method which can be used to ascertain whether a prescribed instructional plan works for the pupil.

The parallel between the work of child study teams in designing and writing IEPs and the competencies science education teachers are expected to attain in the Unified Science sequence strongly indicates that special education teachers and, indeed, all members of child study teams would do well to acquire the process skills. For convenience, the Unified Science competencies are listed next and then they are compared with the actions taken by child study teams.

1. **Observing**
   - A. Identify and name properties of an object or situation by using at least four of the senses.
   - B. Distinguish between statements of observation and inferences.
   - C. State observations in quantitative terms whenever possible.
   - D. Describe observable changes of an object.
   - E. Describe an object so that another person can identify the object in a set of similar objects.
2. **Inferring**
   - A. Construct one or more valid inferences from a set of observations.
   - B. Identify observations that support an inference.
   - C. Describe additional observations needed to test alternative inferences.
   - D. Distinguish inferences that should be accepted, rejected, or modified on the basis of additional observations.

A form of this article appeared as:
Schenkat, R.J. & Battaglini, D. Special education as a great experiment. **Education Unlimited**, 1980, Vol. 5, pp. 18-21.

3. **Measuring**
   A. Order objects by comparing a property that objects have in common, including lengtn, area, mass, and volume.
   B. Describe objects quantitatively using arbitrary units to measure length, area, mass, and volume.
   C. Using appropriate units from the metric system, describe objects quantitatively by measuring their length, area, mass, and volume.

4. **Classifying**
   A. Identify and name observable properties of objects in a set which could be used to classify the objects.
   B. Construct a one, two, or multi-stage classification of a set of objects.
   C. Construct a classification of a set of objects which can be used by another person to identify each of the objects in the set.

5. **Using Numbers**
   A. Work out and discuss proportion problems drawn from a collection of such problems.
   B. Read and write numbers in scientific notation.

6. **Using Space/Time Relationships**
   A. State and apply rules for finding linear speed of various systems, for example, find the linear speed of a rolling wheel given its angular speed and its diameter or circumference.
   B. Describe motions and positions of objects using various reference frames.
   C. Describe places on a map using rectangular and polar coordinate systems.

7. **Communicating**
   A. Construct a graph from a collection of data.
   B. Interpret graphs verbally and be able to interpolate and/or extrapolate points on these graphs.
   C. Write a description of observations made on a phenomenon of your choice.

8. **Predicting**
   A. Make a prediction by extrapolating and interpolating from a self-made graph which describes a set of variables of a self-designed investigation.
   B. State qualitatively the limitations of the reliability of your predictions.

9. **Formulating Hypotheses**
   A. Select from a set of alternative statements those which are hypotheses (as defined by SAPA).
   B. Distinguish between statements which support a given hypothesis and those which do not.
   C. Construct a testable hypothesis from a given set of observations.
   D. Construct more than one hypothesis from a given set of data.

10. **Defining Operationally**
   A. State the meaning of an operational definition.
   B. Operationally define various materials from a set of your observations concerning tests of those materials.
   C. Select a common object and formulate an operational definition that would enable a person unfamiliar with the object to identify it from your definition.

11. **Interpreting Data**
   A. Make and interpret two types of frequency distribution graphs.
   B. Determine measures of central tendency from a set of data.
   C. Use slope to interpret a graph.
   D. Construct sentences that describe relation between two variables.

12. **Controlling Variables**
    A. List a series of variables that have a probable effect on the outcome of an investigation.
    B. Set up an experiment and identify which variables are manipulated variables, which are controlled variables, and which are responding variables.
13. **Experimenting**
    A. Design and carry out an experiment using all of the aforementioned processes that are pertinent.
    B. Defend your conclusions or lack of conclusions regarding your experiment.

"SCIENTIFIC" SPECIAL EDUCATION

Pre-IEP Activities

A critical teacher behavior is the ability to observe. Like scientists, special educators are asked to "state observations in quantitative terms whenever possible." (How rapidly does the child read when he reads this material at 95% accuracy?)

Rigorous classroom experiments often include a description of interrater reliability, that is, the measure of agreement between the observations of two or more people. The scientific analogy is "describing an object so that another person can identify the object in a set of similar objects." Special educators are cautioned not to allow biases to "distort their observations and inference" and only "describe observable changes in an object."

In the initial referral of a child with a possible handicap, the specialist gathers observations in the child's learning environment guided by the reason for referral. Rather than taking a shotgun approach, the specialist starts with the materials used in the classroom and then goes on to "identify and name observable properties of objects in a set which could be used to classify the objects." From the data collected by observation, the specialist is able to classify specific reading errors (i.e., the child misread twelve medial vowel sounds).

Almost simultaneous with the classifying, the specialist begins to make inferences regarding the various observations and classes. In the scientist's language, he/she "constructs one or more valid inferences from a set of observations and identifies observations that support an inference." Going beyond observation (the child misread 12 medial vowel sounds), the specialist now infers that the child reads poorly because he cannot make the symbol-sound match for vowels.

The specialist most likely will not be satisfied with only a tentative inference; he/she will look for other ways of gathering observations (perhaps other formal and informal assessments) to support the medial-vowel and other inferences which may have been made. Again in the scientist's language, the specialist has "described additional observations needed to test alternative inferences and distinguish inferences that should be accepted, rejected, or modified on the basis of additional observations."

The specialist, of course, is not operating in isolation. Some of or all other members of the child study team (psychologist, social worker, nurse, principal, speech and language clinician, regular classroom teacher, and parents) bring the observations they have made and their inferences. This team then examines all these data and reaches consensus on the observation-based inferences. Given the diversity of backgrounds among the team members, the difficulty of this task can be appreciated.

Given the California prohibition of the use of IQ data in placement decisions and the Schenck and Levy (1979) report of Connecticut practices, it seems reasonable to predict that educational specialists in the near future will be expected to employ the true scientific method of observation by directly studying a child's functional disabilities in his usual learning/social environment rather than by using the standardized measures that have enjoyed considerable vogue.

IEP Development

If a handicapping condition is found to be present in the child, then the observation-based inferences now begin to be converted into provisions of the IEP. The latter is very similar to an

experimental design. It has the following components: (a) over-all goals; (b) short-term enabling objectives; (c) specification of objective mastery criteria; (d) listing of materials that will be used; and (e) staff responsibility. Again, very direct parallels can be drawn with the process skills.

In one sense the child study team is conducting an experiment. It is hypothesizing from the team's collective experience with normal and handicapped learners that the instructional activities which will be undertaken (independent variables) will lead to the accomplishment of the goals (dependent variables). Adherence to the scientific method is necessary, however.

It is very easy to state, "The goal for the child is to read at a fourth-grade level." But what does this statement mean operationally? The team determined that the child reads at a 1.5 grade level. What must be done to correct the deficit? Traditionally, intervention took the form of placing the child at the appropriate level of a basal reader and trying to keep him progressing through the series. The scientist would look at the intervention differently: What is the nature of the stimuli in fourth-grade reading material (e.g., average number of syllables in words, length of sentences, percentages of regular and irregular words, type of grammar used in sentences)? Special education practitioners call this "task analysis." The observations gathered earlier should shed some light on how the student responds to these various dimensions? The global fourth-grade reading level has been reduced to its elements — an application of classifying skills.

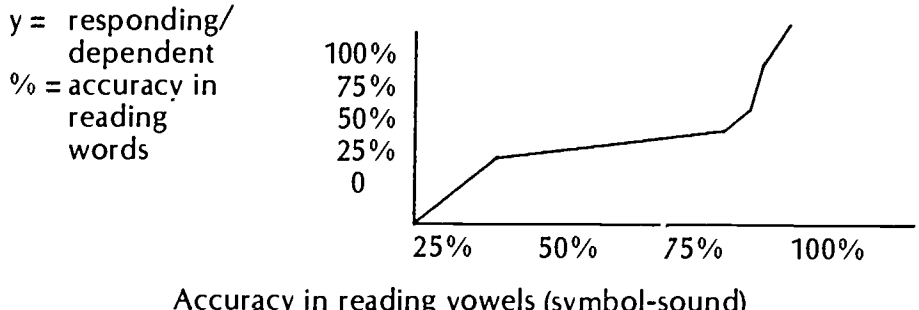
Earlier, the child was said to have difficulty with medial vowels. We can state an operational objective which, if accomplished, will eliminate the child's difficulty with medial vowels: "Upon teacher presentation of one-syllable words on flash cards with any long or short vowel the child will be able to read orally the words at a rate of 30 words per minute with 97% accuracy." Thus, we know explicitly what the outcome of the selected activities should be. Stated in another way, the outcome is hypothesized to bring the child closer to the desired fourth-grade level.

Our hypothesizing now goes one step further. In deciding upon activities to accomplish the objective (the dependent variable), essentially one hypothesizes that the selected activities (the independent variables) will lead to (produce) the objective's outcome. Each activity that is selected should be considered carefully; it is in fact a major component of the experiment.

Scientists use variables. They must "list a series of variables that have a probable effect on the outcome of an investigation and set up an experiment and identity which variables are manipulated (independent) variables, which are controlled variables, and which are responding (dependent) variables."

The scientist, therefore, works very much like the child study team. The outcomes the team desires for a child are the dependent variables; the activities or materials selected and described in the IEP are the independent variables. There also are controlling variables. They are specified in the given of the objective. For example, "one-syllable words on flash cards" is the control in the objective stated. If the child's on-task behavior in completing assignments was desired, an initial control might specify the confines of a study carrel (i.e., given a study carrel, student will complete . . .).

As in an experiment, an outcome or result is expected. It may be positive or negative. Special education teachers often convey their results in graphs and charts.



Accuracy in reading vowels (symbol-sound)
x = manipulating/independent

This use of charting parallels the scientist's work in two ways: (a) scientists communicate much of their findings in graphs and (b) they must defend their results. It must be remembered that from the outset the work is being done only on the basis of inferences and hypotheses. However much experience the special education teacher and the child study team may have had working with handicapped children who manifest the same type of problems, carrying out the IEP is still an individual experiment. It does not assure the desired outcome. The IEP demands the specification not only of the objectives, but also, the criteria that are necessary to indicate learning. Thus the special education teacher can talk of results only by operationally describing the outcomes, that is, the child has improved from 50% accuracy to 97% accuracy as a result of the experiment. This is the only proof that the child reads better.

If the outcome meets the criteria, the teacher can say that the hypothesis (this type of intervention with this type of need) has been supported. The teacher thereby contributes to the theories that an experienced teacher consciously or unconsciously uses. If the outcome has not met the criteria, then the hypothesis has not been supported and a new hypothesis with different variables must be formed. The teacher continues the research until the all-important goal — meeting the child's educational needs — has been achieved.

One further parallel may be drawn between the work of scientists and the demands made on professionals in the development of an IEP. The IEP must specify for each objective the time frame in which it will be achieved. Scientists are called upon to "make predictions by extrapolating or interpolating from a self-made graph which describes a set of variables of a self-designed investigation." The child study team like the scientist makes predictions from the data that are available from diagnostic teaching, the child's past rates of achievement, and rates of learning of similar types of children.

The IEP calls for a number of conditions. In complying with the requirements to meet the needs of handicapped children, the special education teacher and the other team members are using the model that scientists use.

FLAWS IN THE IEP PROCESS

The development and execution of the IEP are of paramount importance in protecting the rights of handicapped children. It is not a legally binding contract under which a child or his parents can bring suit if the conditions are not met, but it is a significant document. Its rigor was established to make sure that no child be subjected again to the old practice of "out of sight, out of mind."

The use of the scientific method brings definition to the IEP and its preliminary and resultant activities. Consider the following six questions which a scientist might ask to greatly improve the IEP process:

1. Are enough observations being gathered?
2. Have sufficient observations been gathered to support making inferences?
3. Do any observations fail to contribute to inferences?
4. Are the inferences of causation instructionally useful for forming hypotheses?
5. Do the experiments begin to approximate accepted practice in scientific research (controlling variables, charting results, operationally defining outcomes, etc.)?

All is not well in IEP use, according to Schenck and Levy (1979). In a study of 300 IEPs for mildly handicapped students (LD, ED, and EMR) in 37 Connecticut School Districts, the researchers found "a lack of a relationship between the psychological assessments and the long-term goals/short term instructional objectives [which] highlights the [absence] of 'specificially designed instruction'. The inability to trace goals and objectives back to diagnostic data raises serious doubts concerning the efficacy of current educational plans" (p. 24). In scientists' terms, experiments are being designed for the instruction of handicapped students without using the observations and inferences which are often gathered at great expenditures of time and money by team members.

Schenk and Levy suggested that the relative lack of training by both psychologists and teachers in the process of relating diagnostic information to 'specifically designed instruction' is a contributing factor to this mismatch.

Perhaps psychologists devote too much time to the garnering of etiological types of inferences that have proven to be of little value in special education remediation (Bateman, 1976). The wisdom of S. Alan Cohen (1969) aired a decade ago in an article on the dread disease Dyspedagogia may be exceedingly important in designing experiments for handicapped children. Cohen demonstrated that independent variables such as direct instruction and time engaged on task allowed for large gains in achievement without identifying causative factors (e.g., minimal brain dysfunction, poor auditory sequential memory, dyslexia, hyperactivity).

Is there a contradiction between using the scientific method and ignoring the causation of handicaps? After all, we depend on science to find causes. But causation of handicaps is a medical problem, not educational, and we do not need to know the cause of a handicap to treat the educational problems a child exhibits. In the medical profession itself treatments for diseases often are discovered and prescribed before etiologies are known.

By the use of the scientific method (remember experiments should be replicable), contributions are made to the body of knowledge on the education of handicapped children. When enough experiments are conducted under similar conditions and have the same outcomes, we can use the findings safely with "at risk" children to prevent problems. In fact, the research question becomes, what intervention can keep children with the same reading problem from having the same type of difficulty?

Another potential explanation for the mismatch between diagnostic findings and "specially designed instruction" comes from the propensity of specialists to use standard measures (e.g., PIAT, Key Math, and ITPS) rather than to gather observations with curriculum-based assessment devices (CBAs) (see Lilly & Blankenship, 1979). CBAs eliminate the "leap" from diagnostic findings to instruction. Also, appropriate CBAs enhance a mainstreamed child's chances to benefit from the classroom curriculum (if it is appropriate).

The type of instructional materials used by the special education teacher is critical. If the specialist develops a sense of comfort with a particular type of remedial material (e.g., DISTAR, Sullivan Programmed Readers, or Peabody Language Kit), the child may become a prime candidate for the favored material irrespective of the diagnostic findings. In such a case, the selection of the experiment's independent variables has been faulty.

The parallel between the IEP process and the scientific method may not be acceptable to those who consider scientific research manipulative. But the scientific method is a set of procedures and a way of thinking. Perhaps it would have more appeal for these teachers if the processes could be described in less impersonal terms. Special education teachers always have had a warm regard for handicapped children.Yet, until special education research shows significant results in solving the children's problems, this warm regard will be more sentimental than useful. The Connecticut data shows that we have a long way to go to insure that the lives of children are being affected by appropriate "experiments."

Regular and Special Education Comparisons

With skepticism abounding on the quality of services provided by "trained" specialists, can we be optimistic about the role of "nontrained" regular classroom teachers in working with the handicapped child? Teachers have been characterized as clinical information processors, decision makers, diagnosticians, and problem solvers who are to specify objectives, select learning activities, organize learning activities, and specify evaluation procedures. Thus, for almost 30 years the regular education teacher-training literature has suggested the use of a rational means-end planning model (Popham, 1970, Taba, 1962, and Tyler, 1950). Taba characterized curriculum planning as "a task that requires orderly and careful thinking, and this model is proposed as a rational and scientific method for accomplishing such a task" (p.3, cited in Clark & Yinger.)

The similarities among this rational means-end planning model, the IEP, and the scientific method are obvious. Perhaps concern with the "untrained" regular classroom teacher is unfounded? The ray of hope for the mainstreamed child seems, however, to be dashed by Clark and Yinger's (1978) study of teacher thinking.

> On the topic of teacher planning, the available literature suggests that teachers do not seem to follow the "rational" model that is often prescribed in teacher training and curriculum planning. In particular, the teachers studied neither began nor guided their planning in relation to clearly specified objectives or goals. Rather, teacher planning seems to begin with the content to be taught and considerations about the setting in which the teaching will take place. The focus then shifts to student involvement — a process objective. The activitiy rather than the objective seems to be the unit of planning (p.38).

From a scientific viewpoint, the teachers studied by Clark and Yinger are making the fundamental error of confusing dependent and independent variables if the outcome expected is academic achievement.

Can we expect teachers to think and operate like scientists? If elementary school children can be taught to use process skills to solve science problems — the premise of the Unified Science sequence at CST — why cannot adults who should know how to learn become adept in the use of the scientific method also? It would be ironic indeed if we accepted teachers in the public schools who did not possess or know how to use the very skills they are expected to teach their charges! The recognized purpose of schools, according to different surveys, is not only to teach basic skills but, also, and perhaps more important, to facilitate the use of thinking skills.

The reason that the rational means-end model has not been widely adopted may be the pace of the modern classroom. According to Durkin (1979), teachers have time to be only "mentioners" of content. In fact, when prospective teachers first enter classrooms to practice their skills, they often are told by supervising teachers to forget the theories of the ivory tower and to focus instead on the methods which have served for generations.

The extensive use of all-encompassing curriculum objectives, pretests, posttests, and so on places the teacher in nothing more than a dispenser role. When the curriculum fails to meet the needs of a pupil, current practice supports labeling the child "handicapped" and referring him to Title I or special education. The teacher is often explicitly discouraged from wondering why the curriculum has failed and designing an experiment to find out. And special education teachers who evaluate the pupil may use only the standard tests they learned.

Perhaps teacher training fails in one critical area: it is not enough for a good researcher to meticulously employ the scientific method, he/she also must know the discipline. Teachers are instructed in methods that it seems, no one expects them to use, and they are assumed to know Reading, Math, Spelling, and Language Arts not only at the level of literacy but also at the level of being able to task-analyze the objectives set for children. But do they? Too many Curriculum and Methods Courses place more emphasis on methods than the content of the curriculum; yet the methods are seldom used and teachers have only a narrow understanding of the subject matter they are supposed to teach

Other than a positive feeling about working with handicapped children, any teacher needs to be able to use process skills to insure that the children receive the remediation they need. Thus rather than calling upon continual proliferation of special education resource services for mildly handicapped pupils, regular teachers should be given the supports (e.g., continuing inservice training to maintain proficiency standards, classroom aides, and various curriculums and supplements) which will equip and free them to work with mildly handicapped children. Unfortunately, present practices of funding school districts discourage such an enlightened policy. It is simple to predict outcomes when the placement of children in special education is rewarded rather than the quality of education in regular classrooms.

This position does not advocate the "dumping" of children in need of special services, however. When IEP objectives are teaching additional facts, phonetics, and language arts, cannot this "special" education be provided as a normal procedure by regular classsroom teachers? Of course,

IEP goals must be met, but in this era of educational responsibility one must wonder whether the quality of education that is universally desired does not depend on the performance of regular classroom teachers rather than additional services.

APPENDIX B

BLOOMING FRESHMEN

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This paper has four purposes. First, we show how the Design for Choicemakers relates to both the historical roots of liberal education and current research on preparation for successful careers. Second, we present the assumptions that underlie our thinking on the educational background of high school students today. Third, we present a model based on an overview of Bloom's Taxonomy. And last, we describe in some detail a model of learning that should be useful at the College of Saint Teresa and other colleges.

Context for the Design for Choicemakers: Past and Future Considerations

One of the best definitions of a liberal education was set forth in 1852 by Cardinal Newman in his address, **The Idea of a University.**

> A University training...aims at raising the intellectual tone of society, at cultivating the public mind, at purifying the national taste, at supplying true principles to popular enthusiasm and fixed aims to popular aspiration...at facilitating the exercise of political power, and refining the intercourse of private life. It gives a man a clear conscious view of his own opinions and judgments, a truth in developing them, an eloquence in expressing them, and a force in urging them. It teaches him to see things as they are, to go right to the point, to disentangle a skein of thought, to detect what is sophisticated, and to discard what is irrelevant. It prepares him to fill any post with credit, and to master any subject with facility. It shows him how to accommodate himself to others, how to influence them, how to come to an understanding with them, how to bear with them. He is at home in any society, he has common ground with every class, he knows when to speak and when to be silent; he is able to converse, he is able to listen; he can ask a question pertinently and gain a lesson seasonably when he has nothing to impart himself...he is a pleasant companion and a comrade you can depend upon....He has a response of a mind which lives in the world, and which has resources for its happiness at home when it cannot go abroad. (pp. 177-178)

An analysis of Cardinal Newman's conception of educational reveals many similarities with the Design for Choicemakers.

In an era when students who complete an expensive educational experience are concerned with finding jobs, a great deal of evidence supports the wisdom of a foundation in the liberal arts tradition. Successful individuals in various occupations were queried to find out what they were doing to make them successful and to examine how and why they are doing what they do (Klemp, 1977). This research found that these successful professionals/individuals exhibited three important traits: cognitive skills, interpersonal skills, and motivation. Klemp described these traits as follows:

Cognitive Skills

1. Information processing skills related to learning, recall, and forgetting.
2. Conceptualizing skills (which) enable individuals to bring order to the informational chaos that constantly surrounds them...such skills go beyond an ability to analyze...they involve an ability to synthesize information from a prior analysis.
3. The ability to understand many sides of a controversial issue. (Persons with this skill can resolve information conflicts better than a person who tries to resolve information conflicts by denying the validity of other points of view; such a person is ill-equipped to mediate

disputes or to understand what her/his position has in common with the positions of others.)

4. The ability to learn from experience...the ability to translate observations from work experience into a theory that can be used to generate behavioral alternatives.

Interpersonal Skills

1. Communication skills. Fluency and precision in speaking and writing is important, of course, but often it is the nonverbal component of communication both in sending and receiving information, that has the greater impact.
2. Accurate empathy...defined as both the diagnosis of a human concern (based on what a person says or how he or she behaves) and as an appropriate **response** to the needs of the person....Accurate empathy helps clients and co-workers understand what is being said or done in a way that make them feel they are understood. There are three aspects to this skill...positive regard for others...giving another person assistance either solicited or unsolicited, that enables the other person to be effective...ability to control impulsive feelings of hostility or anger that, when unleashed on another person, makes that person feel powerless and ineffective.

Motivation

This variable describes a person who habitually thinks in terms of causes and outcomes as opposed to one who sees the self as an ineffective victim of events that have unknown causes. Our own analysis of complex managerial jobs and the people in them has shown that a person who takes a proactive stance, who initiates action and works to dissolve blocks to progress, will, with few exceptions, have the advantage over a person who is reactive, who does not seek new opportunities, but sees the world as a series of insurmountable obstacles.

Thus, from both an historical perspective and current research on what the world of work is seeking in individuals, we believe that the Design for Choicemakers offers unique opportunities for your development as an educated successful person.

THE HIGH SCHOOL GRADUATE'S EDUCATIONAL BACKGROUND: ASSUMPTIONS

Rowe (1983) suggests that K-12 teachers operate implicitly from a model of learning that views students as bottomless receptacles of information. The teachers' function, thus, is to convey information and to correct students' recitations. Knowledge is seen as a fixed commodity to be stored for future use—"learn it now: you'll need it next year; learn the official story, regardless of whether you believe it or understand it."

Similar to Rowe's insights into students learning the "right answer" or the "official story" is the supposition by Arons (1983) that knowledge received from authority figures is accepted as final truth. Further, he indicates that this result is not limited to K-12 levels, given the increasing evidence that colleges are not doing a very good job of helping students to learn beyond the knowledge state in any of the formal disciplines.

As a result of your learning experiences up until your entry into college, we assume that like most students you tend to view knowledge as only a collection of information. Further, students often see their role as one of receiving information or knowledge and then demonstrating that they have learned the right answers by recalling them on tests. The role of the instructor is seen as one of giving knowledge to the student; the good instructor is respected as a knower of the truth. Understanding the K-12 educational experience, also, leads us to assume that students are not likely to see peers as a legitimate source of knowledge or learning. Finally, it is likely that evaluation is directly related to the sense of self (bad/wrong answer equals bad/wrong person). Also, evaluation should be clear-cut because the questions asked and answered should be clear-cut.

The following chart contrasts our assumptions for a typical high school graduate and our goals for a CST graduate. The goals are taken from research on cognitive development and reflect how a total college experience contributes to individual growth.

Chart 1

A COMPARISON OF EXPERIENCES: HIGH SCHOOL AND CST GRADUATES		
	High School Graduate	**CST Graduate**
View of Knowledge	Knowledge is a collection of information.	Truth can exist within specific context and is judged by "rules of adequacy."
Role of Student	Receive information or knowledge and demonstrate that the right answers have been learned.	Learn to think for oneself and to use supportive evidence.
Role of Instructor	Give the knowledge to student. A good instructor equals Absolute Authority and is Knower of Truth	Expert/guide/consultant within the framework of "rules of adequacy."
Role of Peers	Peers are not a legitimate source of knowledge or learning	Peers are legitimate sources of learning if they use appropriate rules of adequacy and contextual presentation of perspectives. Seek out diversity of opinions and experiences of others. Position alone does not determine legitimacy; process does.
Evaluation Issues	Evaluation directly related to sense of self (bad/wrong answer = bad/wrong person). Evaluation should be clear-cut, because questions asked and answers should be clear-cut.	Evaluation of work separated from evaluation of the self. See evaluation as opportunity for feedback, improvement, and new learning.

The information on the preceding chart is based on the work of William Perry as expanded by J.L. Cornfeld and L.L. Knefelkamp. Perry has devoted over thirty years to the study of college students' cognitive development. (If you care to know more about Perry, you may wish to read **The Modern American College**, edited by Arthur W. Chickering, 1981; it is available in the College Library.)

MODEL OVERVIEW

An expanded version of Bloom's Taxonomy of Cognitive Learning is presented in the next section. The taxonomy was developed in the early 1950s to conceptualize the types of learning taking place in a college setting (mainly for the task of evaluation). The concern at that time, was that not only at the K-12 level but, also, at the college level students tended to be evaluated for

the acquisition of facts rather than for the ability to learn. This tendency led to some narrow conceptions of the process of learning (see Chart 1, left-hand column). Bloom and his associates wanted to devise a system that would more uniformly insure that process goals were set for college classes and that students would be evaluated at levels of thinking higher than the memorization of facts.

Beyond the purpose of evaluation, there is great value in your knowing the taxonomy because it provides a framework for explaining the learning process at CST. The model, which is shown in Diagram 1 and further broken down on Table 1, considers learning above the knowledge level. In addition to the knowledge level, learning can occur at the comprehension level, application level, analysis level, synthesis level, and evaluation level. Each of these six levels is broken down into sub-areas, as is shown in Table 1. For instance, the comprehension level is subdivided into translation, interpretation, and extrapolation. We consider this diagram to be a representation in a way, of how the brain functions in the assimilation of learning experiences. When we faculty members share this way of viewing learning, we can be somewhat consistent in helping you to learn. The details of Diagram 1 are elaborated on in the rest of this paper.

DETAILED DESCRIPTION OF THE MODEL

1.0 Knowledge

Although literal, authoritative knowledge is considered to be at the bottom level of thinking skills, this knowledge is important, it is needed to interact with our higher levels of thinking. The following quotations by Gagne and Moore are illustrative:

> It is not uncommon to hear disparaging statements about 'facts' and 'mere verbal knowledge' among teachers and other educators. The major reason for the expression of this point of view may be a desire to emphasize high-priority goals that are more difficult to attain, such as 'teaching students to think creatively.' Verbal information, after all, is learned quite readily; and much of it will be acquired incidentally in study that has other primary objectives. However, the priority assigned to information (knowledge) should be tempered by considerations of the positive usefulness of this type of human capacity. An important use for verbal information is as a vehicle for thought. One should not lose sight of the fact that the great thinkers we admire are likely to be the men and women who have vast stores of knowledge. The relational, connective, functions of thought seem to require the propositional form presumably taken by information in the organized mode it assumes in human memory. (Gagne, pp. 200-201)

Moore's (1967) comments reflect the importance of acquiring knowledge in a somewhat structured fashion.

> Most propositions, however, are acquired directly or indirectly from . . . [human] culture . . . that complex body of knowledge, beliefs, customs, laws, mores, and arts which man acquires as a member of society. We can only speculate on the amount of knowledge you could acquire if you had to get it all by trail and error and induction. (p. 258)

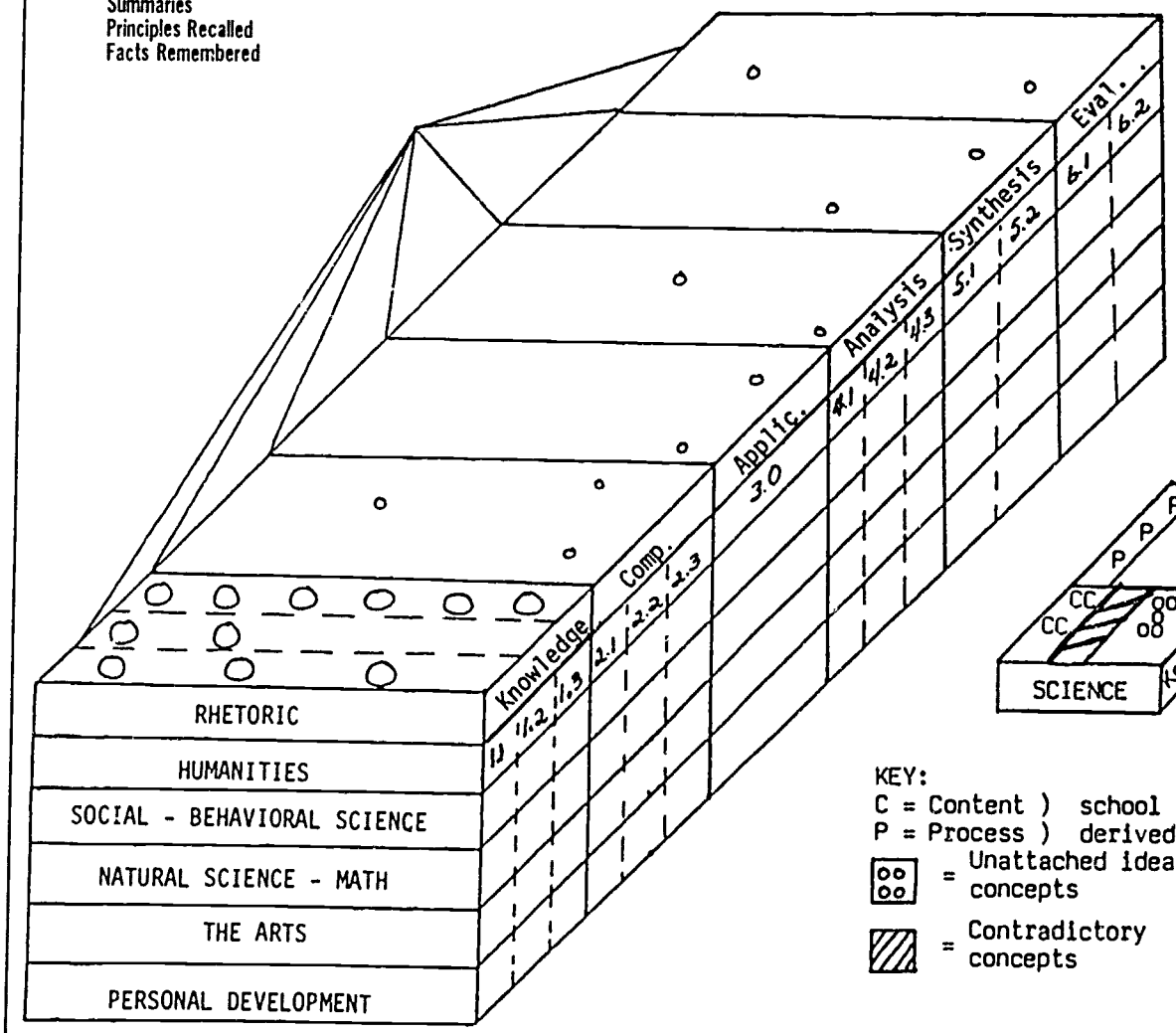
Simply summarized, knowledge is necessary because it is the fuel that fires thinking. A careful study of the knowledge level of Bloom's Taxonomy indicates that knowledge is much more than facts . It is, rather, a whole system of viewing how humans collect and organize knowledge. Instead of viewing what you must learn as so much isolated information, you acquire an understanding of how the contents of disciplines are organized according to standard conventions. What the Dewey Decimal System did for the organization of different kinds of books in a library, Bloom's Taxonomy has done for the ordering of knowledge. If you consider the quantities of content that are found in the Desirable Characteristics areas of Aesthetic/Cultural Development and Breadth of Experience, you will recognize the need for some kind of organizational system to make the learning and recall of the content possible.

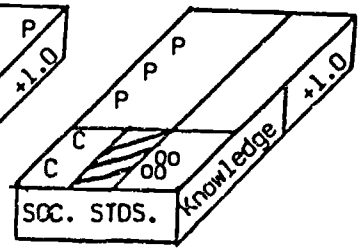
Although diverse courses like Cultural Anthropology, Developmental Psychology, Introduction to Philosophy, Basic Sociology, American Government, and History of Civilization seem to have little relation to each other, the Task Force that developed Bloom's Taxonomy realized neverthe-

DIAGRAM 1

Output: Critiques
Reports
Problems Solved
Projects Designed
Methods Applied
Summaries
Principles Recalled
Facts Remembered

-How much of this box did schools build?
-Characteristics of the Learner





KEY:
C = Content) school
P = Process) derived
= Unattached ideas, concepts
= Contradictory concepts

Input:
-TV
-School Instruction
-Peers
-Home
-Reading
-Etc.

Source: Bloom's Taxonomy of Cognitive Learning.

Table 1

Categories and Samples of Levels of Learning
(From Bloom's Taxonomy of Cognitive Learning

1.0
Knowledge
1.11
Knowledge of Terminology
1.12
Knowledge of Specific Facts
1.21
Knowledge of Conventions (ways of treating & presenting ideas & phenomena)
1.22
Knowledge of Trends & Sequences
1.23
Knowledge of Classifications & Categories
1.24
Knowledge of Criteria (by which facts, principles, opinions, are tested)
1.25
Knowledge of Methodology (such as methods of inquiry)
1.31
Knowledge of Principles & Generalizations
1.32
Knowledge of Theories & Structures
2.0
Comprehension
2.10
Translation (paraphrasing of communication)
2.20
Interpretation (comparative relationships, relationships of deduction, relationships of inductive generalization, & cause & effect relationships — at the use level)
2.30
Extrapolation (extension of trends beyond given data)
3.0
Application
(A problem at the 2.20 category requires the student to know an abstraction well enough to correctly demonstrate its use when specifically requested. At the application — Problem Solving — a student is to be given a novel problem & not prompted as to which abstraction is to be applied in this situation.)
4.0
Analysis
(Requires conscious knowledge of the parts & processes of reasoning)
4.10
Analysis of Elements (Identify unstated assumptions & distinguish facts from hypotheses)
4.20
Analysis of Relationships (Check consistency of hypotheses with given information & assumptions for comprehension of interrelationships among passage ideas)
4.30
Analysis of organizational principles
5.0
Synthesis
5.10
Production of unique communication
5.20
Production of a plan, or a proposed set of operations (proposed ways of testing hypotheses)
5.30
Derivation of a set of abstract relationships (formulate appropriate hypotheses & modify in light of new factors)
6.0
Evaluation
6.10
Judgment in Terms of Internal Evidence
6.20
Judgment in Terms of External Criteria

less that many underlying similarities could be identified. On the basis of these similarities the group developed a classification scheme comprising the following elements at the knowledge level:

1.11 Terminology.
1 12 Specific Facts.
1.21 Conventions (Ways of Doing Things).
1.22 Trends and Sequences.
1.23 Classifications and Categories.
1.24 Criteria.
1.25 Methodology.
1.31 Principles and Generalizations.
1.32 Theories and Structures.

To show the relevance of these elements to Aesthetic/Cultural Development, let us look at some of the objectives for different courses in that area. (The objectives are lettered for convenience and not to denote an order.)

a. Know the methods of Cultural Anthropology.
b. Know the sequence of developmental issues from conception to death.
c. Know the methods of observation in Developmental Psychology.
d. Understand the basics of the two major movements of American Philosophy— Transcendentalism and Pragmatism.
e. Identify the structural components of the American Political System.
f. Know the important sociological theories and concepts.
g. Know the early evolution of human beings.

These objectives can be sorted according to the classification outlined by Bloom's associates.

Objective	Knowledge Category
a.	1.25
b.	1.22
c.	1.25
d.	1.32
e.	1.11 & 1.12
f.	1.32
g.	1.12

Your adoption of the Bloom organizational scheme offers you a way to see every class from a new perspective. Rather than isolating the contents into Unit 1, Unit 2, etc., you can look for patterns in the content. Then you may be able to see the framework underlying each course and build upon it to understand the course structure.

Each course, in a sense, represents a new language (terminology). The language is the discipline's particular way of commenting on the world. Although terminology may differ from course to course, similar structural components like criteria, methods, etc., transcend these differences to reveal relations that can help you to discern more comprehensive frameworks.

In your careful consideration of the knowledge level of Bloom's Taxonomy note that knowledge relates to more than just the recollection of facts. At the 1.20 level, the foundations are set for the process skills that you will learn in Freshman Seminar. At the 1.30 level, the structure is developed for much of the Breadth of Perspective that we hope this college experience will give you. Familiarity with Bloom's Knowledge Level should allow you to acquire knowledge in an orderly systematic fashion that has purpose. Remember that this knowledge is the fuel for higher levels of mental operations.

You may recall from a high school psychology course, or you will soon learn in your introductory psychology courses at the College of Saint Teresa, theories of learning and how easy it is for information to be forgotten. Most of this research has been based on the learning of nonsense syllables or unrelated words in which the key, as evidenced at the end of Gagne's quote, is to form relations in learning, to relate content to previously known things. In Diagram I, the righthand portion of the page, a layer of learning called "science" is shown. The front half of it is

labeled, "knowledge," which consists of three parts. In the first part are unattached ideas and concepts which one has not taken the time to relate to each other. Second, learning research currently suggests that children and adults have misconceptions. Finally, there is a kind of learning that comes from formal instruction. It is our hope in formal instruction that the number of unattached ideas/concepts and misconceptions will be reduced.

Many of these concepts need to be integrated into larger units. Suppose we consider the knowledge segment of the block in Diagram I as a warehouse storing all this information, but the warehouse is not completely tight and has many large holes through which information escapes. The larger these concept clusters, therefore, the less likely they are to slip through the holes in the warehouse's structure.

Inteiiectual Abilities and Skills

Our focus now shifts to intellectual abilities and skills. This section is extremely important for you if your schooling up to this point has been similar to that described by Rowe and Arons in "Faculty Assumptions on High School Graduates' Educational Backgrounds." The use of the intellectual skills and abilities derived from Bloom's Taxonomy (on a daily basis at Saint Teresa's) should do much to help you acquire more than a store of knowledge which may be easily forgotten.

Klemp (1977) offers a strong statement on the importance of these intellectual abilities and skills:

> . it is neither the acquisition of knowledge nor the use of knowledge that distinguishes the outstanding performer, but rather the **cognitive** skills that are developed and exercised in the process of acquiring and using knowledge. These cognitive skills constitute the first factor of occupational success. (p. 103)

Comprehension

2.0 Translation Level If you memorize the wording of someone else's ideas, they most likely will stay that person's ideas until you forget them, but if you paraphrase those ideas they are more likely to enter your frame of reference. Thus, in your pursuit of an education, it is extremely important for you to constantly paraphrase new ideas until they become yours. Also, learn to reorder your learning into segments that relate to your existing knowledge and are meaningful for you.

If these suggestions are new to you and you have trouble studying and remembering, you may wish to adopt the following suggestion: "The way in which information is encoded determines how it is stored, which in turn determines what retrieval cues will effectively provide access to it."

By way of example, the following suggestion reflects the value of translation (Bloom category 2 10) If you try to memorize the above quote you probably will not recall it a week later, but if your convert the Terminology (1.11) into your own ideas (the process of translation), you most likely will remember it better. For example, one translation could be, "If after I read something, I say it back in my own words, it will help me when I'm asked to recall the information."

In the knowledge section, we drew an analogy between the "science" portion of Diagram I and a warehouse. The balance of the diagram might be likened to your personal home or dwelling. The more you take out of storage from that impersonal warehouse and put to work, that is, translate into your own ideas and link with existing related ideas, the more the learning will become your own and have meaning for you. In your psychology course work you will learn about schema theory developed by such psychologists as Piaget. This personalizing or linking of knowledge is very consistent with his notions. Also, in the area of artificial intelligence, which you may encounter in your studies, you will read about the concept of scripts; they, too, are similar to schema.

2.2 Interpretation Level. All higher levels of thinking are refinements of, or put special emphasis on, intellectual processes that are found in embryonic form in interpretation. The essential characteristic of interpretation is that facts, generalizations, definitions, values, and skills are related to each other. You will find it useful, at this point to read again the quote from Gagne which starts the section, "Detailed Description of the Model."

A. Comparative Relationships

Definition: The student determines whether ideas are identical, similar, different, unrelated, or contradictory. The question often asks for evidence to support the answer.

Examples:

1. . . . in a . . . unit on comparative regions in the United States, the students are asked: *Is the climate of Rockport, Maine, different or the same as that of Frostproof Florida?* . . .
2. Another type of question asks for degrees of similarity. *Which two communities are most similar in the amount of rainfall each year? (A)Frostproof, Florida; (B) Greenville, Mississippi; (C) Window Rock, New Mexico.*
3. Students may be asked to relate two or more sets of ideas on specified points (e.g., compare two civilizations on religion and government).
4. ...The most challlenging comparison questions leave it up to the student to determine the topics on which two or more general sets of ideas are comparable . . . (Sanders, 1966, pp. 44-45).

   . . . A difficulty . . . is that if [a] comparison has any significance the author or teacher has probably already called it to the attention of the students and the question changes to one of memory (Sanders, 1966, p. 46).

Comparing and contrasting questions are very much tied to the skills of classification and sorting. Bloom's Taxonomy provides a common framework which easily leads to comparing and contrasting Think how easy it would be to respond to a question such as, "Compare and contrast the *methods* (Bloom's 1.25 Level) of Developmental Psychology and Cultural Anthropology." Without the category label (methods) the task would be much more difficult.

Essay questions often take the form of compare and contrast questions. The key is to find the common category. The procedure is a valuable study and learning technique.

Relations of implications, inductive generalizations, and cause and effect are only covered briefly here because they are discussed at length in Freshman Seminar.

B. Relation of Implications

By definition, an implication is "the relation that holds between two propositions, or classes of propositions, in virtue of which one is logically deducible from the other" (*Random House College Dictionary,* rev. ed.). *Deductive* thinking, a form of reasoning, permits you to examine sets of facts, recognize the implications of each, and so ascertain whether they are related or unrelated to each other and specific questions. For example, in political science you will learn about the characteristics of different forms of government, such as a republic, an oligarchy, a dictatorship, a theocracy, and a democracy. Suppose you were asked, subsequently, whether it is possible for an oligarchy to be a democracy. To answer, you would relate the proposition (a), oligarchy is rule by few, with the proposition (b), democracy is rule by the many. In short, deductive reasoning starts with accepted propositions.

C. Inductive thinking

In contrast, consider the drawing of conclusions from premises which may or may not support the conclusions. For example, when a child burns a finger with a lighted match, on a red hot poker, and on a lighted electric bulb, the child might conclude that all bright objects burn and then suffer scalding from boiling water because it is not bright. Nevertheless, inductive reasoning is essential to creative thought because it permits one to go beyond evidence, to see the possibilities in new and not yet accepted information. Without the ability to make inferences, our thinking would be sadly limited. In most scientific research, one bases one's assumptions usually on

inferences, establishes a hypothesis on the basis of the assumptions, and then tests the hypothesis. In short, deductive reasoning moves from the general to the specific, whereas inductive reasoning moves from the specific to the general.

D. Cause and effect relationships

A "cause" makes something happen. Push the electric switch to "on" and the bulb in a lamp lights up (providing all parts are in working order); if the bulb does not light up, we look for the cause of the malfunction. But what is the ultimate cause of the lamp light? It certainly is not the finger because that digit has merely opened a connection. Is it the open connection? Well, it could be, but that is only because the connection permits the electricity to flow through and activate the bulb. Then what is the cause of the lamp light? Electricity.

You will hear considerably more about cause and effect during Freshman Seminar. One important aspect of education is being able to distinguish actual from spurious cause-effect relations.

3.0 Application. A problem in the Interpretation (2.20) category requires students to know an abstraction well enough to be able to correctly demonstrate its use when they are specifically asked to do so. Application (Problem Solving) requires a step beyond interpretation. Given a problem that is new to students, they should be able to apply the appropriate abstraction without having to be prompted as to which abstraction is correct or shown how to use the abstraction in that situation. When a student meets a problem in life, no teacher is present to give directions. Application questions give practice in independent use of knowledge and skills.

4.0 Analysis. The distinctive feature of the analysis category is that it requires solutions of problems in which **conscious knowledge of the parts and processes of reasoning** must be used. In interpretation and application, the emphasis is on using subject matter to arrive at conclusions; they do not require the student to give special attention to the process involved. For example, the definition of interpretation states that the category includes both induction and deduction; these forms of thought can be used without knowing their definition or nature. In analysis, there continues to be a concern with subject matter, in addition, however, the student must be conscious of the intellectual process he is performing and know the rules for reaching a valid conclusion.

The name of the Swiss theorist, Piaget, was mentioned earlier. You either know or soon will be learning about his four stages of cognitive development in whch formal operations are at the highest level. The awareness in a student's mind during Level 4.0, Analysis, is very similar to some current research in psychology that is known as metacognition.

Metacognition refers to conscious **knowledge** and **control** of the domain of cognition. **Knowledge** of cognition refers to subjective information on one's cognitive processes and those of others. For instance, what is my proficiency? Your question on proficiency is incomplete. Proficiency in what? As of now, the question is meaningless. Can you describe the procedures involved in your own memorizing, reading, studying, problem solving, classifying, logical reasoning, proposing of multiple hypotheses? Knowledge of metacognition requires learners to step back and look at their own cognitive processes as objects of thought and reflection.

The full functioning of process skills, metacognition, and Piaget's formal operations are very similar. At the stage of formal operations, the entire thinking process is carried out in one's head, that is, on the mental plane. The learner can consciously invent, test, modify, and generalize theories mentally and discuss these operations with others (Brown & Bransford, 1982). Lawson et al. (1984) described it as the ability to ask questions not of others but of oneself, and to reflect on the correctness or incorrectness of the answers to those questions in a hypothetico-deductive manner because one has internalized the key linguistic elements of argumentation. The latter are the abilities to recognize and/or generate language in which hypotheses, predictions, results, and conclusions are or can be formulated. Formal operations, in which the individual has conscious knowledge of the processes that are guided by linguistic elements, can be equated to the general model's level 4.0.

A cognitive tool that is stressed heavily in the freshmen seminar at the College of Saint Teresa is the Toulmin Model of Reasoning. This gives you a language which allows you an opportunity to step back and to consider your own cognitive processes. The rationale for learning the Toulmin Model may be better understood if you realize that its purpose is to give you, your classmates, and faculty members a common language in which to think about thinking.

5.0 Synthesis. Synthesis involves the putting together of elements and parts to form a whole. The process is one of arranging and combining pieces, parts, elements, etc., to form patterns or structures that could not be seen clearly before. Thus, it is possible to take current ideas and rearrange them to create some new kind of synthesis. Synthesis comprises three sections: production of a unique communication, production of a plan, or derivation of a set of abstract relationships. Sanders (1966) gives some notion of the characteristics of a person adept at synthesis.

> Creativity in any field requires certain skills, but, more than that, it requires a certain temperment and personality. The creative person has a questioning mind — a sensitivity to problems. He is a bit of a renegade with a restless disposition that "cannot leave well enough alone." He cannot accept any dogma as being so well established that it is beyond doubting and questioning. A high fluency of ideas, including novel ones, is another sign of creativity. A creative person has a flexibility that makes possible dramatic conceptual changes, but he is not a scatter brain flitting haphazardly from idea to idea. He has a sound conceptual organization of his field and an ability to translate, interpret, apply, analyze, and evaluate, as well as synthesize. He has a tenacity of purpose that makes it possible to overcome the inevitable frustration involved in the process of discovery. Philip Jackson and Jacob Getzels in their study of creativity at the University of Chicago note that many students with high intelligence quotients tend to seek the "safe" answer to a question....These students accept the idea that the teacher and the textbook can be relied upon as the guide to learning. The creative student glories in discovering a different answer that can be logically or artistically justified.
>
> Synthesis thinking is not so closely tied to the form of the questions as is true in other categories but instead is fostered by a classroom atmosphere that seeks and rewards originality. In the definition of almost every previous category, it was noted that students may demonstrate creative thinking by figuring out an accurate and sometimes ingenious answer that the teacher does not anticipate....(p. 126)

6.0 Evaluation. Evaluation consists of judgments on the value of material and methods for given purposes. Quantitative and qualitative judgments are also made on the extent to which material and methods satisfy given criteria or use of a standard or appraisal. The criteria may be those determined by the student or someone else. Evaluation looks at judgments in terms of either internal evidence or external criteria. When one judges something by internal standards, one assesses the general probability of accuracy in the reported facts from the care given to the exactness of the statement, documentation, proof, etc. To judge by external standards is to compare a work or performance with the highest known standards in its field — especially with other works of recognized excellence.

How Behavioral Objectives Help You

If you refer back to the section, "Detailed Description of the Model," you will notice that many of the objectives listed there do not give many details. This condition makes it more difficult for a student to know exactly what are the learning expectations for a course. It may aid you in learning, however, if you take nonspecific objectives (e.g., will learn/will know) and convert them into specific study goals for yourself. You may also want to ask your instructor to set out specific objectives to help you study. There is given in "Verbs Matched to Bloom's Levels" a series of verbs that match up with each of the model's levels.

VERBS MATCHED TO BLOOM'S LEVELS

1.0 Knowledge
answer questions, choose, define, finish, complete, follow directions, identify, indicate, label, list, locate, match, select

2.0 Comprehension
classify, compare the importance of (not just compare, which is Level VI), derive, describe, estimate, expand, explain, express, interpret, measure, put in order, recognize, suggest, summarize, trace, convert, add, balance, calculate, compute, divide, factor, multiply, subtract, write numerals

3.0 Application
apply, compute, construct, make, draw, demonstrate, differentiate, discuss, express in a discussion, find, use, collect information, keep records, participate, perform, plan, predict, prepare, present, solve (word problems, problem situations), use

4.0 Analysis
analyze, debate, determine, differentiate, form generalizations, deduce, draw conclusions, make inferences, organize

5.0 Synthesis
combine and organize, design, develop, produce, write (an original composition)

6.0 Evaluation
compare (and contrast), make a decision, decide, evaluate

Courses do not generally have only knowledge-level objectives. Consider the following objectives from the courses we looked at earlier:

Analyze and **compare** the similarities and differences that are found in civilizations.

Apply social theories to understand human behavior.

Analyze American politics through the **application** of basic concepts in political science.

Use methods of Developmental Psychology to **carry out** original research.

In these objectives you can see how knowledge is used and how it is brought together with specific process skills. (Note the use of verbs.) Also, courses such as Freshman Seminar and Rhetoric have goals centering on sharpening your process skills so they can be used in your other core and elective courses.

A series of student-expected outcomes objectives follow. Your ability to master these objectives will enhance your use of Bloom's Taxonomy.

1.0 Knowledge

1. List the nine subordinate levels of knowledge in Bloom's Taxonomy (Terms, Facts, Conventions, Trends, and Sequences, Classifications, Criteria, Methodology, Principles, and Generalizations, Theories, and Structures).
2. Define the nine subordinate levels of knowledge in Bloom's Taxonomy.
3. Explain, using examples, the nine subordinate levels of knowledge in Bloom's Taxonomy.
4. Sort (differentiate) objectives into appropriate Taxonomy level.
5. Compare and contrast 1.10 and 1.30 level objectives.

2.0 Comprehension

1. Translate an abstraction, such as general principle, by giving example.
2. Translate from symbolic form to another.
3. Formulate accurate inferences and tenable hypothesis — recognizing the data continuation.
4. Predict continuation of trends.
5. State factors which may render prediction inaccurate.
6. Differentiate value judgment from predictions of consequences.

3.0 Application

1. Apply principle, postulates, theorems, or other abstractions unprompted to new situations.

4.0 Analysis

1. Recognize unstated assumptions.
2. Differentiate facts from hypothesis.
3. Differentiate a conclusion from statements which support it.

4. State the interrelationships of ideas of passage.
5. Recognize which facts or assumptions are essential to a main thesis.
6. Differentiate cause-and-effect relationships from other sequential relationships.
7. Analyze the relations of statements in an argument to distinguish relevant from irrelevant statements. Identify logical fallacies in arguments.
8. Infer the author's purpose, point of view, or traits of thought and feeling as exhibited in his work.
9. Identify techniques used in persuasive materials, such as advertising propaganda.

5.0 Synthesis

1. Demonstrate writing skills using excellent organization of ideas and statements.
2. List ways of testing hypothesis.
3. Produce effective plan to solve problem which integrates results of investigation.
4. Formulate appropriate hypothesis based upon an analysis of factors involved, and modify such hypothesis in light of new factors and considerations.
5. State possible ways in which experiences may be organized to form a conceptual structure.

6.0 Evaluation

1. Judge works by internal standards, such as consistency, logical accuracy, and the absence of particular internal flaws.
2. Identify and appraise judgements and values that are involved in the choice of a course of action.
3. Compare a work with the highest known standards in its field.

Summary

This paper presents the historical and vocational rationales for the Design for Choicemakers. Further, it sets out assumptions that are based on a typical high school graduate's views on learning. Finally, Bloom's Taxonomy is elaborated on as a guide to a student's structure of learning and the acquisition of intellectual skills and choicemaking abilities at the College of Saint Teresa.

APPENDIX C

APPLYING CRITICAL THINKING SKILLS IN PRESERVICE TEACHER EDUCATION CLASSES

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Section I

Introduction

Critical thinking and reasoning have been the major themes in the Unified Science sequence and Introduction to Liberal Studies courses. At least three different models have been incorporated to meet this goal. These models are alluded to in this paper as

I. The Science Process Model (or Unified Science Model)
II. The Syllogistic or Logic Model (where syllogisms are created and analyzed)
III. The Toulmin Model (Claims, Warrants, Grounds, etc.) from the text **Introduction to Reasoning** by Toulmin et al.

These models are applied specifically to Teacher Education training. This chapter is intended to be used as a resource in working with teacher education faculty members or students. It is set out in the seven following sections:

Section II

Glossary and Background for the Three Models

Critical thinking as it is identified in the courses of Unified Science and Introduction to Liberal Studies can be best described as achievement of certain **process** skills. Most of these skills, with a brief description, follow:

1. **Observing:** the use of the senses. The quality of observing is determined by the number of observations one can make as well as the number of senses one uses to make the observations. The student is also sensitized to the difference between a statement of

observation and a statement of inference. Perceptual differences, bias, and frame of reference are key concepts the student is exposed to in lessons on observation. In stating observations ambiguous semantics should be replaced with quantifiable or less qualitative identifiers.

2. **Inferring:** An inference is a statement that is based on observation but in itself is not an observation. "It is wood" is an inferential statement whereas, "It looks like wood" is a statement of observation. The student is asked to describe observations that are needed to test an inference, distinguish inferences that should be accepted, rejected or modified on the basis of additional observation, and construct one or more valid inferences from a set of data. The logic rules of immediate inference are also taught under this topic.
3. **Classifying:** The student is expected to be able to sort objects, observations, inferences, phenomena, etc., into mutually exclusive and exhaustive categories. Multistage, hierarchical classification is emphasized in Unified Science. In the course, Intro. to Liberal Studies, the student is expected to be able to identify classes, create hypothetical propositions, and analyze arguments.
4. **Using spatial and space/time relationships:** Some of the key concepts of this skill are speed, velocity, acceleration, rate of change of position, angular velocity, and relative position and motion. Orthogonal drawing of scenes, interpreting orthogonal drawings, and geometric transformation are some of the activities used to increase spatial reasoning ability.
5. **Communicating:** Creating and interpreting graphs, and describing a phenomenon in written and oral form are two subskills of communication. Critical reading and listening are stressed. For example, the student in Intro. to Liberal Studies is expected to be able to distinguish premises from conclusions of an argument by searching for a variety of "cue" words. Preparing, presenting, and critiquing position papers and debates are three of the techniques used to foster the skill of communication.
6. **Predicting:** The student learns to make valid extrapolations and interpolations from graphs or data. Also, he/she can state qualitatively the limitations of reliability of the prediction. The student in Intro. to Liberal Studies is taught the technique of using the predictive statement as a means of creating the major premise in a hypothetical syllogism (If-Then).
7. **Hypothesizing:** This skill, as used in the Unified Science sequence and Intro. to Liberal Studies course, is the formation of an inference that generalizes categorically to a classification. The statement of an hypothesis should be in measurable terms, that is, all key terms should be operationally defined. Students learn that it is the manner of science to test the null hypotheses as a means of either rejecting or failing to reject the research hypothesis. The logic and fallacies of types of hypothetical syllogisms are taught in Intro. to Liberal Studies and are applied to real situations in Unified Science.
8. **Interpreting Data:** This process includes a variety of subskills such as organization of data, construction of graphs, determining measures of central tendency, measures of range, measures of dispersion, interpreting slope, to name but a few. This skill goes beyond the use of skills of tabulating and graphing and asks generally what inferences can be drawn out of the data.
9. **Operationally Defining:** This type of definition answers two basic questions, (1) what operation or act was done, and (2) what observations were made. This is a skill that is exemplified by behavioral objectives. The products of the skill are **clarity** of thought and **clarity** of communication of intent. Values clarification involves the use of this skill because it forces the student to describe clearly a frame of reference.
10. **Controlling Variables:** Use of this skill helps the student identify factors that are in cause-effect relationships. In this process the student soon learns to manipulate an assumed causal factor to see its effect on a dependent variable. The success of identifying causality will depend on the student being able to prevent outside factors from changing.
11. **Experimenting:** The student is **either** asked to create and answer a question **or** answer a question created by someone else. The answer is accomplished by an experiment designed and carried out by the student using the aforementioned skills. The answer (which may be "undetermined by these data") is defended by the student.

These terms are common in science but have a variety of different uses in colloquial language. The same is true with other models of reasoning as is pointed out shortly. It is therefore very

difficult for the student (as well as the teacher) to automatically transfer from one model to another without confusion.

It is not the intent of this paper to teach the processes of reasoning (as mentioned before) but to **facilitate** the task for knowledgable faculty members. Following is a model that is used in the Intro. to Liberal Arts course. The model has similar but not exact cross meaning with the Unified Science skills. The model also has similarities to standard terms of logic. This paper now attempts to cross match and explain the terminology of all three models.

The Toulmin Model

This model of teaching reasoning is presently employed in the Intro. to Liberal Studies course. The Toulmin model utilizes the following concepts,[1]

1. Claims
2. Grounds
3. Warrants
4. Backing
5. Rebuttal

The concepts are used by an **assertor** who is making the claim and/or a **questioner** who is analyzing the claim. The student is asked to identify, classify, interpret and/or construct parts of arguments or an entire argument based on these concepts. Before showing how this is done please read the following dialog and definitions of the concepts.

Dialog between two faculty members of a college (where A_1 is the first quote of the assertor and Q_1 is the first quote of the questioner).

A_1: "You know, I really think that the freshmen class has less ability to think critically than other years. I gave them their third quiz on analyzing arguments yesterday and the results were miserable. These students were an average of 20 points lower on this exam than last year."

Q_1: "Was the test more difficult than usual?"

A_2: "No! I used the same test last year."

1. **The claim.**

Claims are conclusions. As a result they usually are statements of inference. Identifying the claim in an argument allows the listener or reader to focus on the important factors surrounding a claim. In the previous dialog the claim is asserted in A's first quote, "...the freshmen class has less ability to think critically than other years."

Being a generalized statement also makes the claim an **hypothesis** (as used in this document). It is therefore subject to testing by questioning the evidence leading to it. The claim usually is the starting point or the destination (or both) of an argument.

Before a critique of a claim can proceed, ambiguous terms must be identified and clarified. In an experiment this process would be similar to **operationally defining,** and **communicating.**

Often the claim is identified by cue words or phrases such as, **therefore, it follows that, hence, so implies that,** etc.

2. **The grounds.**

The grounds are the statements that are used to support the claim. The assertor in an argument for a position usually states one or more propositions to clarify or make good the claim. These propositions can take on the nature of observational or inferential facts. The questioner is responsible for identifying the nature of the type of fact so that he/she may question the reliability of the fact. That is, if the fact is a statement of observation certain potential weaknesses should be examined, such as perceptual bias, perceptual difference, scant corroborative observation, and others. If the fact is inferential then a different kind of examination is necessary to glean out potential weaknesses. For example one should question how the inference was determined.

One needs to check all **grounds** for relevance by looking for cause/effect relationships between grounds and claim. Usually when this is accomplished a hidden premise or generalization is uncovered. This is known as the **warrant.**

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[1]The text used to teach this model is *An Introduction to Reasoning* by Toulmin, Ricke, & Janik, New York: Macmillan, 1979.

3. **The warrant.**

The warrant is analogous to the major premise in a syllogism. Sometimes the warrant is explicitly stated but more often it is implied or unstated. The claim, grounds, and warrant therefore could be put into syllogistic form such as,

Warrant = Major Premise = "All A, B, C are D"
Grounds = Minor Premise(s) = "This is an A, B, C"
Claim = Conclusion = "Therefore, this is D"

As an example to illustrate a warrant that is missing examine the following dialog.

Teacher #1 "Boy, the kids sure are rowdy today."

Teacher #2 "Of course, it's a rainy day."

These two statements, although short and simplistic, imply a great deal of logical connection. The statements, when analyzed under the Claims-Warrants model, are as follows:

Statement #1: "Boy, the kids sure are rowdy today." (grounds)
Statement #2: "Of course, it's a rainy day." (claim)

The warrant which is implied is, "Rainy days make children rowdy." Of course other implied warrants might be assumed from the same two statements. The questions must make explicit a suggested warrant so that reasoning can be employed. Once the warrant is identified as the logical connector between grounds and claim, it can be held up for examination and analysis.

Identifying and or creating the warrant relies on one's ability to classify and hypothesize. Sorting out the grounds and looking for common elements is the process of **classifying.** Synthesizing the common grounds into a cause effect relationship between grounds and claim is a skill alluded to under the process **hypothesizing.**

Once the relationship (warrant) is created that links the grounds to the claim then both the logic and the reliability can be ascertained. The following scenario illustrates an illogical connection.

Teacher #1: "Boy, the kids sure are rowdy today."
Teacher #2: "Of course, [because] it's a rainy day."
Teacher #3 in a chiding way to Teacher #2: "What do you mean? Her kids were rowdy yesterday and it was clear!"

Teacher #3's conclusion does not necessarily follow. The following symbols represent the syllogism implied by the conversation.

1. **Major premise:** If A then B
2. **Minor premise:** not A
3. Conclusion: not B
   INVALID FORM

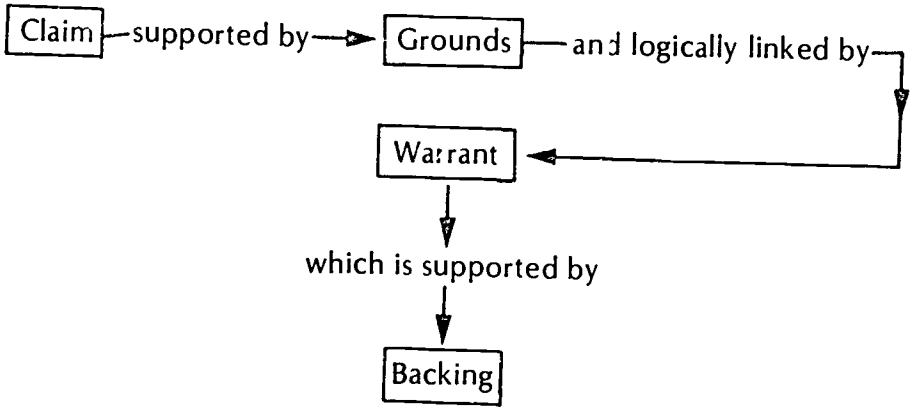
1. **Major premise:** "If it's raining then children will be rowdy."
2. **Minor premise:** "It's not raining (or wasn't yesterday because it was clear)."
3. Conclusion: Children won't be rowdy (missing but implied by teacher #3's comment.)

Without going into the formal rules of logic and syllogisms, the point is that one must **know** the warrant before checking its reliability **or** validity.

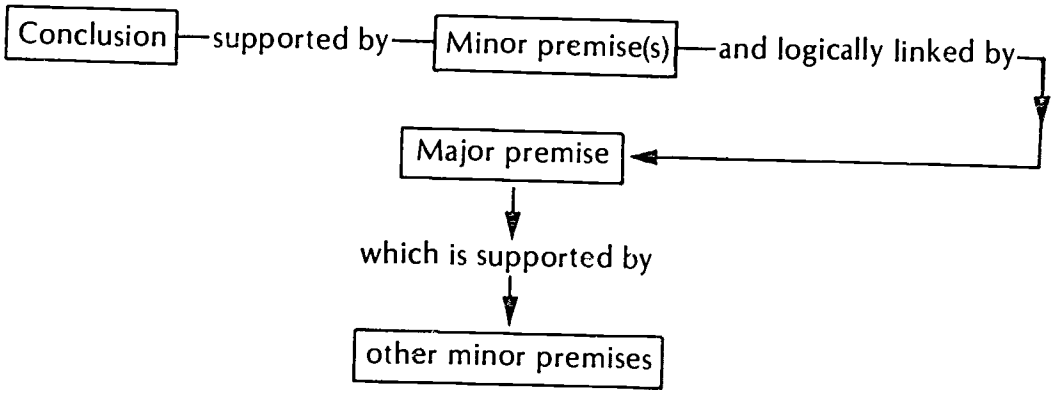
4. **Backing.**

The warrant has been shown to be the major premise from which a conclusion is drawn. Once the warrant is accepted as logical it must be examined for reliability. The questioner's role now becomes one of asking for facts that support the warrant. These sets of facts are the backing.

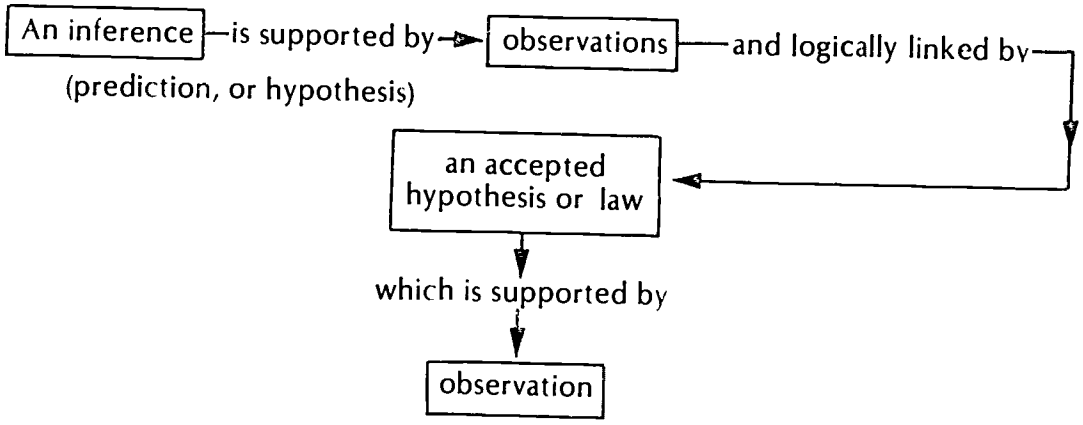
Backing is to the **warrant** as **grounds** are to the **claim**. One might schematize the thought process like this:



Using other terms for logic the model is thus:



Using process terms as in Unified Science the model is as follows:



It becomes the questioner's role to ask the assertor for backing if the warrant is under suspicion. The backing must be relevant, clear, reliable, and logical.

Fallacies of relevancy are usually discussed at length in textbooks on reasoning. They fall under descriptors such as **illegitimate appeals** or **informal fallacies.** Here are some examples:

1. Illegitimate appeals to authority, masses, pity, threat, etc.
2. **Ad hominim** or attacks against the person.

Fallacies of ambiguity are mainly

1. amphiboly — occurs because of faulty grammar, and
2. equivocation — where confusion exists over a word that is used differently in the some argument.

The degree of reliability ror backing is in one sense the probability that the fact is correct. The more a student is informed of statistical analysis the more likely she/he will spot subtle misuses and abuses of statistics. The questioner must listen for the term called the **quantifier**[2] in the categorical proposition.

Here are several propositions that illustrate the quantifier or lack of it.

Proposition	**Quantifier**
1. All children love animals.	All
2. Girls like to climb trees.	All? Some? Most?

Propositions of **backing, claims,** and **grounds** usually don't contain universal quantifiers like all, no, every. This is especially true in ordinary conversation where people are wary of stereotyping. However, in missing premises and assumed **backing** universals **are** implied by the very reasoning that is employed.Take for example the two propositions on children and rainy days.

1. "Boy, the children sure are rowdy today."
2. "Of course, it's a rainy day."

Again the implied link is "Rainy days cause children to be rowdy." It would be an illogical statement to draw the conclusion from "some" (although safer). Therefore the implied quantifier must be **all** to make for a valid conclusion. It is very important to get students to listen and check for the quantifier.

Rebuttals are situations that are possible exceptions to the rule. Rebuttals should be mentioned by the assertor to make clear that she is aware of the exceptions. This in turn takes away a potential counterpoint by the questioner.

The questioner's role then is to look for statements of presumption that are exceptional to the warrant or spot a misuse of a quantifier term. Even if the assertor points out exceptions the questioner must distinguish statements that **might** disqualify the warrant from those that **would** disqualify a warrant. This skill is closely related to understanding the difference between **necessary** conditions and **sufficient** conditions. The questioner must be very versatile in looking for cause/effect relationships.

If there are no rebuttals mentioned by the assertor then possible rebuttals are created by the questioner. The first step is to get the quantifier term (modal qualifier) of the assertor's warrant identified and then to proceed as before.

Summary

The results of learning the three models (Process, Logic, Toulmin) of reasoning facilitate the task of preparing classroom material for applying reasoning skills to education content. Table 1 summarizes questioner's responsibility, neccessary loci, and useful process skills.

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[2]Modal qualifier is the term used in in the Toulmin model and is similar to the term "quantifier" in the logic model.

TABLE 1

SUMMARY OF QUESTIONER'S RESPONSIBILITIES, NECESSARY FOCI, AND USEFUL PROCESS SKILLS

Concept	Questioner's Responsibility	Focus necessary	Example of useful process skills (not exhaustive)
1. CLAIM	(a) must be identified	listen for "cue" words such as therefore, hence, so, etc.	observing, communicating
	(b) must be clarified	identify ambiguous terms like semantics, qualitative modifiers	observing, defining operationally, inferring
2. GROUNDS	(a) must be identified and separated from claims and other statements	sort into facts, observations, inferences	observing, classifying, inferring, communicating
	(b) must be checked for relevance	look for cause and effect relationships	classifying, inferring, controlling variables
	(c) reformulated more specifically and precisely where possible	listen for semantics and ask for less ambiguous terms	observing, operationally defining
3. WARRANTS	(a) must identify the generalization from which claim is drawn. This is usually the major premise of a syllogism.	when explicitly stated, look for cue words or phrases like **since, for, because, given that, in view of, one may infer, one may deduce, as illustrated by, if.**	observation
	(b) must create and state generalization implied if the warrant is apparently missing	create categorical or hypothetical syllogisms and supply missing logical premises or connector, e.g., If A then B / A / ——— / therefore B	classifying, inferring, hypothesizing
4. BACKING	(a) must ask the assertor for evidence and data leading to the warrant	look and listen for unsupported warrants, e.g. truisms, axiomatic statements, dogmatic statements, in other words, **modal qualifiers**	observing
	(b) must sort relevant from irrelevant backing	look and listen for illegitimate appeals to authority, masses, compassion, threat or force, etc.; **ad hominem** attacks, ambiguity, amphiboly, equivocation	classifying
	(c) must sort reliable from unreliable backing	look, listen, and ask for statistical quantifiers and qualifiers like all, never, most, sometimes. Seek out, identify uncontrolled variables	observing, classifying, interpreting data, predicting, operationally defining, controlling variables

TABLE 1 (CONTINUED)

	(d) must identify fallacies of logic when used by asser-tor	look for fallacious reasoning like If A then B not A --- therefore not B or A or B -B --- therefore not A	observing, classifying, hypothesizing
5. REBUTTALS	(a) must be identified when stated by assertor	look for statements of pre-sumption that are excep-tional to the warrant. Identify modal qualifiers	observing, commu-nicating
	(b) must be analyzed when stated by asserto,	distinguish between statements that **might** dis-qualify the warrant from those that **would** disqualify a warrant, also apply rules of immediate inference to detect fallacious reasoning	hypothesizing, inter-preting, data inferring
	(c) must be created by the questioner when omitted by the assertor	question the assertor on which modal qualifier is be-ing presumed and proceed with items in a and b	hypothesizing

Section III

How to Create Scenarios for Applying Reasoning Skills

Below is an overview of steps a faculty member could use to create situations conducive to practicing reasoning.

I. Select any content area such as
   - A. Educational Psychology
   - B. Teaching of Reading, Math, Social Studies, Science
   - C. Child and Adolescent Psychology *or* any subject within those areas such as
   - D. Discipline
   - E. Developmental stages
   - F. Lesson and Unit Planning
   - G. Theories of Learning
   - H. Writing Behavioral Objectives

II. Find sections in the selected area that make claims or generalizations.

III. Either write a paragraph that applies the claim to a dialog that you create,

or

have students read a specific paragraph from a text,

or

videotape selected classroom vignettes.

IV. Have students analyze the paragraph using one of the three models summarized in the last section (Process Model, Logic Model, Toulmin Model).

or

Have the students analyze via models the videotaped lessons of the classroom situation using one or more of the models.

Getting Started

The most difficult part of the outline is not in selection of content but in operationalizing what it is you want the student to do. Begin by picking a subtask of reasoning, such as identifying warrants, claims, and grounds, and write an operational objective.

Example Objectives

Objective I. (a) Given a paragraph or scenario, or videotaped vignette that contains an explicit claim, some explicit grounds, and an implied warrant, the student will state in writing the identified claim and grounds and create and state in writing the warrant from which the claim is drawn.

(b) Given the claim and warrant write a chain of inferred propositions that one might use to logically connect the claim to the warrant.

Next, find or create a paragraph or dialog that contains the necessary ingredients and write a set of specific questions that match your objective. Try to write in colloquial language and "load" the dialog with enough controversy to stimulate discussion.

For example,

Teacher A "These kids really had difficulty with this math test."

Teacher B "What's it on?"

Teacher A "Division of fractions. We just started fractional division on Monday and I gave them the test this morning. Only Susan got them all correct and most of the kids missed at least 25%. Some of the 'mainstreamers' missed them all but I guess that's to be expected."

Questions for students (answers follow)

1. What is the claim? _____
2. What are the grounds for the claim? _____
3. Identify any explicit or implicit warrants. If none write "none." _____

Or using the *process* model write operational objectives with one or more process skills. Here are some examples.

PROCESS OBJECTIVES

Objective II. Given the scenario above the student will

(a) identify and distinguish statements of observation from those of inference,

(b) create a test for each inference cited in (a),

(c) make each inference into an hypothesis (or rule) and write a short description of how each hypothesis might be tested.

Finally, using the syllogism model write a set of operational objectives that analyze the same scenario. Here are some examples.

SYLLOGISM OBJECTIVES

Objective III. Given the scenario above the student will

(a) identify premises and related conclusion(s),

(b) create either a categorical or hypothetical syllogism that illustrates the logic of the scenario,

(c) state whether the conclusion is valid or invalid and give at least one reason why it is invalid if invalid,
(d) identify premises that need to be checked for reliability and state at least one critical question that could be asked for the check of each premise.

Some answers for each set of objectives are illustrated on the following pages.

Upon answering the items that test the objectives you will probably note that the major differences in the approach are those of terminology. Following the exercise answers you will find an expanded version of the previous scenarios and an expanded set of questions one might generate to move preservice teachers into the habit of thinking critically.

Objective I.

Question 1. The claim is, "These kids really had difficulty with fractions."

Question 2. The grounds stated are,
(a) ". . .only Susan got them all correct."
(b) ". . .most of the kids missed at least 25%."
(c) ". . .some of the 'mainstreamers' missed them all."

Question 3. One warrant suggested by claim and grounds is,
"A class of children where most of the class misses at least 25% and only one student gets all items correct is a class that's having difficulty with this test."
Another warrant is, "Classes with 'mainstreamers' are classes where some children miss all times."

Objective II. (a) statements of observation are
". . .division of fractions"
"We just started fractional division on Monday"
". . .I gave them the test this morning."
". . .Only Susan got them all correct"
". . .most of the kids missed at least 25%"
". . .some of the 'mainstreamers' missed them all"
(b) statements of inference are
"These kids really had difficulty with this math test."
". . .but I guess that's to be expected."
(c) One test[3] for the inference "these kids really had difficulty with fractions" might be,
(1) Operationally define "difficulty." For example, compared to what? Last years results? An operational definition could be — "difficulty is defined as being the situation where 80% of the students in a class miss 80% of the items."
(2) Next, identify what other inferences might be rivals to the stated inference. For example, *The test wasn't difficult in terms of content* but *in terms of difference of format.* Or, *the test didn't measure what the teacher taught,* etc. In this example test of an inference the situation perhaps is not practical but the process of determining *how* to test is of extreme value for practicing reasoning.
(3) Control variable of rival inference. For example, control for format and control for similarity of items used in teaching with testing.
(4) Check test for reliability. Are the smarter students missing a proportional number of items compared to less smart children?
(5) Although some control is lacking, give the same test to another class of similar students at the same level, say the other 5th grade class in the same building and

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[3]In this example test of an inference the situation perhaps is not practical but the process of determining *how* to test is of extreme value for practical reasoning.

check the reliability again. This could give the experimenter indications of whether the format of the test was difficult or methodology was suspect.

(6) The inference "but I guess that can be expected" suggests a generalization on the part of the teacher. Generalizations can become hypotheses by inserting an "all" or "none" qualifier. Consider for example the hypothesis "all classes containing 'mainstreamers' are classes where some children miss all the items." The purpose of the assertiveness quality of the hypothesis makes it measurable and meaningful. The null hypothesis would become, "some classes containing mainstreamers are not classes where some children miss all items."

Either the original or the null *has to be* correct. Both can't be simultaneously correct nor simultaneously incorrect. This quality of mutual exclusiveness and exhaustiveness allows one to *reject the original* or *fail to reject* the original. In other words an hypothesis and its null form should be *contradictory* not just *contrary*. The reason for this is the fact that "all" is usually difficult or impossible to measure but the quantifier "some" is usually easier to measure.

Objective III. (a,b) One syllogism that can be expressed contains the following:

Major premise that is implied — "All classes with 'mainstreamers' are classes where some children will get 100% incorrect responses."

Minor premise — All classes like this class contain 'mainstreamers'.

Conclusion — All classes like this class will have some children that get 100% incorrect responses.

(c) The conclusion is *valid if* the major premise is true. The minor premise is a subset of the first category of the major premise (classes with 'mainstreamers'). Therefore, the minor premise also shares the qualities of the second category as stated in the conclusion.

(d) The major premise must be checked for reliability. Teacher A is not giving any particular reasons for the generalization (major premise) that she/he is concluding from. What does she/he mean by 'mainstreamers'? What is she/he suggesting? What evidence does she/he have for such a premise? Is the evidence substantial and reliable?

Following is an expanded version of the scenario so that the reader may see how objective II (b,c) and other process objectives can be promoted.

Section IV

Expanded Version of a Scenario

Teacher A "These kids really had difficulty with this math test."

Teacher B "What's it on?"

Teacher A "Division of fractions. We just started fractional division on Monday and I gave them the test this morning. Only Susan got them all correct and most of the kids missed at least 25%. Some of my 'mainstreamers' missed them all but I guess that's to be expected."

Teacher B "Well don't be too hard on yourself. I've had difficulty teaching fractions every year that I've taught. Kids are just naturally going to have problems with that subject so allow for it and give that section more time.

"By the way, have you looked at the exams for *patterns* of mistakes? I've read a book on error patterns in computation and it shows you how to do it. I know it will take more time grading the papers but in the long run you'll probably increase your efficiency."

Teacher A "Here's Jason's paper. Show me how it works."

Exercises for the expanded scenerio

For the moment play the role of teacher B. You have been given a portion of Jason's test. You are to show Teacher A how you think through a problem. Write down your considerations as responses to the questions asked. Do not be concerned if you find yourself reconsidering or

changing your original answers. What is important is that you write down your thoughts as they come to you so that you will later have a model to work from.

First, work the problems and state the rule by which you arrived at your answers.

A. $\frac{4}{12} \div \frac{2}{4} = \frac{2}{3}$

B. $\frac{12}{4} \div \frac{3}{2} = \frac{4}{2}$

C. $\frac{6}{8} \div \frac{3}{4} = \frac{2}{2}$

D. $\frac{3}{6} \div \frac{6}{2} = \frac{2}{3}$

1. State **your** rule for dividing these fractions. _____

_____

_____

2. Next, examine Jason's answers and conjecture what rule he might be using to get his answers?
Jason's proposed rule: _____

_____

_____

3. Teacher B states that the following two problems will test your claim. Apply your guess of Jason's rule by proposing answers to the following two problems as if Jason were working the problems. Jason's answers are given at the end of this section with two rules consistent with the data.

E. $\frac{6}{9} \div \frac{2}{3} =$

F. $\frac{3}{8} \div \frac{3}{16} =$

What would you expect Jason's answers to be?

E. Answer = _____ F. Answer = _____

4. Let us now assume that enough children (four) are apparently working the problems using either of the proposed rules to warrant a new version of the test. The purpose of the new version is to test which rule (1 or 2) is being used. (It follows that the same information could be obtained by asking the students to verbalize their rules of operating on division problems but that is not possible since all of this fictitious.)

Examine the following four problems (G, H, I, J). The results of four students are found in Table 2. Look at the results and see if either rule #1 or #2 is being used.

Test on Fractions

G. $\frac{4}{6} \div \frac{2}{2} =$

H. $\frac{2}{3} \div \frac{8}{6} =$

I. $\frac{12}{3} \div \frac{9}{3} =$

J. $\frac{3}{4} \div \frac{3}{1} =$

TABLE 2.
STUDENTS' ANSWERS TO G, H, I, J

Student #1	Student #2	Student #3	Student #4
$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{1}{3}$
$\frac{1}{2}$	$\frac{2}{1}$	blank	blank
3	$\frac{3}{1}$	3	$\frac{3}{2}$
blank	blank	$\frac{1}{4}$	$\frac{4}{3}$

Select an appropriate response.

4a. For student #1 the answers indicate that (circle appropriate letter)
A. Rule 1 is probably being used, but rule 2 probably is not being used.
B. Rule 2 is probably being used, but rule 1 probably is not being used.
C. Either rule 1 or 2 is probably being used - can't tell.
D. Neither rule 1 nor 2 is probably being used.

4b. For student #2 the answers indicate that (use the same alternatives for your selection as listed in #4a)
A.

B.

C.

D.

4c. For student #3 the answers indicate that
A.

B.

C.

D.

4d. For student #4 the answers indicate that
A.

B.

C.

D.

Let us now turn our attention back to the expanded dialog between Teacher A and Teacher B.

5 What is the **claim** (conclusion) explicitly expressed by Teacher A?

6. Identify the **grounds** on which the claim is being made.

7. What is the **implied** generalization (warrant) from which the claim seems to be drawn?

8. What is the backing for the generalization?

9. What are some possible rebuttals for the warrant?

10. What are the statements of observation and statements of inference? Check (✓) each category for the following excerpts from teacher A's first response.

	Observation	Inference
(a) "[It is on] division of fractions."	☐	☐
(b) "We just started on fractional division on Monday."	☐	☐
(c) "I gave them the test this morning."	☐	☐
(d) "Only Susan got them all correct."	☐	☐
(e) "and most of the kids missed at least 25%."	☐	☐
(f) "Some of my main-streamers missed them all."	☐	☐
(g) "but that's to be expected."	☐	☐

11. Using the code σ (sigma) = statement of observation, I = statement of inference, and N = neither observation nor inference mark each phrase of Teacher B's second response.

12. Read the following quote and answer the questions. "Some of my mainstreamers missed them all but that is to be expected."

A. Major premise (implied): _____

_____

B. Minor premise: _____

_____

C. Conclusion: _____

_____

13. Does the conclusion logically follow from the premises? That is, is the conclusion warranted given the implied and explicit premises.

14. Is the implicated premise reliable? _____
What backing is illustrated or known about it?

15. Read the following quote from Teacher B and analyze it by answering the following questions.
Teacher B:
"Well don't be too hard on yourself. I've had difficulty teaching fractions every year that I've taught. Kids are just naturally going to have problems with that subject."

16. What is the conclusion (claim) being drawn in the quote?

17. What are the grounds or support (minor premises) that Teacher B is using to justify the conclusion?

18. What is an implied premise that warrants the conclusion? (There may be more than one.)

19. Write a brief **rebuttal** for the implied premise you have selected.

20. Write a brief supporting argument for the implied premise you have selected.

On the following pages you will find additional samples of scenarios that include material appropriate for practicing the objectives in the last section.

SELECTED ANSWERS

2. Two possible rules that the data "fit." (There may be others.)
   Rule 1: Divide the larger top number (numerator) by the smaller top number and the answer will be the numerator of the answer. Do the same for the denominators.
   Rule 2: Invert the ratio on right and multiply the numerators and denominators.

3. Jason's answers to 1 and 2 are $\frac{3}{3}$ and $\frac{1}{2}$, respectively.

12. Implied
   Major Premise: All situations involving 'mainstreaming' are situations where all math problems are missed.
   Minor Premise: This was a situation involving 'mainstreaming.'
   Conclusion: This was a situation where all math problems were missed.

13. Valid.

14. Unreliable due to lack of evidence.

SECTION V

Tips on writing scenarios that focus on specific concepts

Specific concept(s)	Tips on Writing
1. Claim	(a) Write an argument containing a conclusion specified with cue words such as **therefore, so, hence,** etc. (b) Include ambiguous terms such as many, most, some and semantics such as large, small, good, bad.
2. Grounds	Write facts, observations, perceptions, inferences. Also include weak cause-effect and strong cause-effect relationships between claims and grounds.
3. Warrants	Have a generalization in mind when writing the claim. This generalization should not be specified however since the task of inferring the implied warrant is important for the student to practice.
4. Backing	Here is where the scenario should be expanded to include the supposedly relevant facts backing the claim. Here again is where cause-effect factors should be analyzed. Write both weak and strong relationships. Any theory should have backing and ask students to include the type of information that would be both good and poor backing.
5 Modalities & Rebuttal	Use words like **certainly, presumably** and other phrasing showing the degree of relationship. Other words or phrases that are modal qualifiers are **apparently, very possibly, possibly, it seems,** and others. Rebuttals include the exceptions to the case, if any, so write propositions that have subtle exceptions rather than blatant exceptions.
6. Observing	Write situations where erroneous or multiple perceptions are possible. Examples should be events which the observer is not likely to remember, the observer lacks the technical knowledge, the physical conditions are not favorable, or insufficient corroboration has been evidenced.

Inferring/Hypothesizing	Write a scenario that contains facts or observations surrounding an event or claim. Put in relevant and irrelevant data. Have students reach a tentative generalization that explains all the relevant facts and observations. To test inferences or hypotheses variation of factors must be included in the data and irrelevant data should be added to make the hypotheses more difficult to measure. Ask the student to **create** the inference rather than selecting an appropriate given inference.
Controlling Variables	Create at least two rival inferences, i.e., both could be possible to explain an effect. The student must be asked to create a test and foresee results of that test that would definitely reject or fail to reject the proposed cause/effect relationship.
Classifying	Have students sort objects, concepts, phenomena into mutually exclusive and exhaustive categories or sets. Also have them identify what the common elements of the sets are. Select phenomena that have more than one common characteristic. Also select phenomena where the commonality exists in the interaction effect between two or more factors and not in the individual factors themselves.
Operationally Defining	Write situations where observations, inferences, predictions, hypotheses, facts, goals, objectives, etc., are **poorly defined.** That is they have ambiguity in meaning. Have students operationalize the definition by stating it in such a way that two questions are answered: what action was performed — and what observations were made regarding the performance. Writing good behavioral objectives is an act of teaching the method of operationally defining.
Predicting	Scenarios of this type must have data with trends. However, also give examples of non-directional data so that a more realistic situation is presented.
Syllogisms	A syllogism literally means "to say together." Write statements which are related to a conclusion and you usually have a syllogism imbedded in the text. Syllogisms take on several forms: (where **PQR** symbolize the classes of a proposition.

Hypothetical Form (one example)

If P then Q	Major Premise
not Q	Minor Premise
therefore, not P	Conclusion

Categorical Form (one example)

All P is Q	Premise
All Q is R	Premise
therefore all P is Q	Conclusion

Disjunctive or Alternative Form (one example)

Either P or Q	Major Premise
not Q	Minor Premise
therefore R	Conclusion

Hypothetical Chain (one example)

If A then B	Major Premise
If B then C	Major Premise
If C then D	Major Premise
not D	Minor Premise
not A	Conclusion

Syllogisms usually have premises and conclusions identified by certain "cue" words. Conclusion cue words: **thus, therefore, then, hence, implies that, so hence, proves that,** and others.
Premise cue words: **because, if, for, since, in view of,** and others.
These words do not **guarantee** a premise or conclusion but usually strongly suggest them.

SECTION VI

On Value Clarification: As A Product of Critical Thinking

An important subject in teaching critical reasoning is value clarification. All thoughtful decisions and actions that follow these decisions result from a person's system of values. These values are in many cases an undefined state and are often in conflict with other sets of undefined values. This situation fosters traits of indecisiveness, ambivalence and dependence on others to make one's decisions. By using strategies of value clarification a person can bring to light troublesome thoughts about decisions that have to be made and feel more assertive about the decision. The guilty conscience syndrome is an example of value conflict.

One of the major goals of The Intro. to Liberal Studies course is to let students encounter strategies for clarifying their own values. The course planners use value clarification as an application of the critical reasoning process to one's life goals. Students apply the value clarification model to investigating their decisions regarding career/life planning. A portion of the rationale given to the students via the syllabus reads:

> An important focus of this course is value clarification. Because our values play a great role in the decisions of our lives, we should be clear about our values and the manner in which we act upon them. We identify and clarify our values as a part of our critical reasoning process. In this course we will look at values clarification as a specific application of our critical reasoning skills.

Education majors need a clearly defined set of operationalized values in their personal philosophy toward educating children. In addition they also should learn the clarification techniques so that these skills can be taught to their students. Research indicates that discipline problems decrease in the classroom when these strategies are employed. These strategies would be of extreme importance in mainstreamed classrooms where the potential for discomfort and ill-feeling exists with one's handicapped peers. Johnson and Johnson[4] report that building positive relationships between handicapped and normal-progress students is the first priority of mainstreaming. At the end of this section there is a list of objectives for teaching value clarification skills that can apply to the mainstreamed classroom.

For the moment turn your attention to the model used at the College of St. Teresa[5] and see how it relates to the Process and Toulmin Models. The Raths-Simon[5] model of value clarification proposes seven sub-processes.

Prizing one's beliefs and behaviors
1. prizing and cherishing
2. publicly affirming, when appropriate

Choosing one's belief and behaviors
3. choosing from options
4. choosing after consideration of consequences
5. choosing freely

Acting on one's beliefs
6. acting
7. acting with a pattern, consistency, and repitition

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[4]Johnson & Johnson (1980).
[5]Raths, Harmin, & Simon (1966).

Here are four objectives from the course Intro to Liberal Studies regarding value clarification (reworded). The student:

(a) can **infer** personal values from **observed** behavior
(b) can **operationally define** several major values that lead her to her career/life choice
(c) will **classify** a set of values for internal consistency
(d) can **classify** the major influences in the development of these ideas.

Thus it is evident that the process skills are applied to value clarification.

Next, the Toulmin model fits nicely into the situation if the tasks can be worded appropriately.

The student:

(a) can state a **claim** or claims of her personal set of values and illustrate the observed **grounds** on which the claim is based,
(b) can identify the **warrant(s)** or major values from which the personal values were synthesized,
(c) will check the **warrant** for internal consistency with the **claim** and **grounds,** and
(d) will identify the **backing** in the development of the **warrant**.

In implementing the course Intro to Liberal Studies each of the three models has been utilized with equal success.

The career/life project that students do is one that is reported to be of great value to them. As freshmen most are not firmly entrenched in a career choice. However most have the desire to have a label attached to their goal so that when talking to others they can report that they are working on a "computer science," or "psychology," or "education" degree. The value clarification process as applied to career/life planning adds one more layer of "screening" for people entering a major.

Section V11
Critical Thinking Exercises: Several Examples of Scenarios

SCENARIO 1

Mr. Kramer has been given an anonymous note suggesting that some students are not being honest on his tests. At the first opportunity he decides to be more observant of his class in order to determine the reliability of the note. The following statements summarize incidents that will later be analyzed by you.

1. Mr. Kramer was walking around the back of the room when he **heard a sound** he could not immediately identify.
2. Then he heard the sound again and realized that **it was made by a student somewhere in the front of the room.**
3. Being suspicious of the honesty of some of his students he says in an agitated voice, **"I heard someone whispering answers!"**
4. At that moment **he sees Beverly hand John an eraser**. Beverly and John sit in the front of the class and across the aisle from one another.
5. Mr. Kramer links what he saw and heard and sheepishly says, "Please do not communicate in any way with each other during a test for any reason. Otherwise I **might conclude that you are passing information to one another.**"

Exercises for students

1. Classify the **underlined** phrases in the five statements above according to the following list.
   A. Observation
   B. Inference
   C. Sensation
   D. Perception

2. Select all passages listed as observation and indicate the grounds on which you would question each observation.

Grounds

A. Physical conditions were unfavorable
B. The observer was not objective
C. There wasn't enough corroboration
D. The observation is not accurate enough
E. The observer lacked necessary sensory acuity

SCENARIO 2

Miss Lund, a student teacher in first grade, was attempting to demonstrate the rudiments of T-Ball[6] to her children in a physical education class. The regular Phys. Ed. teacher had introduced the game in previous classes and Miss Lund was expected to spend at least five hours of time on team skills.

After several days of the activity Miss Lund was forming the opinion that T-Ball was perhaps too boring for her children because most were not attentive to the game. For example, the slightest distraction would capture their attention. In one case an airplane passed overhead and most of the children in the field were looking up when a ground ball rolled past them. The longer the game proceeded the less attention was given to the game.

Later, she related this situation to the Phys. Ed. teacher. The Phys. Ed. teacher instructed Miss Lund to observe Mrs. Blackburn's 2nd graders because they were very attentive thus suggesting that Miss Lund was perhaps lacking in some skills for motivating her 1st graders.

The following week Miss Lund had a chance to observe the 2nd graders playing T-Ball and indeed they seemed much more attentive to the game. Miss Lund also noticed that the 2nd grader's physical skill development was about the same as the 1st graders. Errors were common place but apparently the errors were due to the lack of physical dexterity not inattentiveness.

She asked Mrs. Blackburn how she kept the children more attentive to the game and her reply was, "I reward effort to get to the ball with tokens. Last year I taught 1st graders and had the same experience as you did. The children did not pay attention. So this year I thought that I would give T-Ball one more try, only this time with reinforcement for appropriate behavior and it worked!"

A few years later Miss Lund was in graduate school and was deciding on a master's thesis topic. She had read that children's attention span increases dramatically around the seventh year of age and she recalled Mrs. Blackburn's statement concerning reinforcement. Miss Lund decided that she would use reinforcement theory vs. maturation theory in an experiment for her master's thesis topic.

1. Create a critical question that could be used by Miss Lund as the basis for an experiment.
2. Design an experiment that would determine an answer to question #1.
3. After the design is created for #2, hypothesize some possible data results and determine the type of conclusion(s) that could be drawn given those data results.
4. Present your design to a panel of peers for external opinion and be prepared to defend all potential conclusions that one could infer.
5. List weaknesses in design that were necessary due to uncontrollable factors and defend your reasons for allowing weaknesses in design.

SCENARIO 3 (with explanation of answers)

Mrs. Thompson has begun her planning for a reading comprehension unit. A colleague, Mrs. Jones, has told her that there were many worthwhile activities in the Wisconsin Reading Design-Comprehension (WRDC). This program was in the instructional media center of her school and

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[6]T-Ball is like baseball except children hit the ball off a tee thus eliminating the need for a pitcher.

Mrs. Thompson carefully reviewed it. She particularly liked the strand in the program on reasoning skills as she thought it was extremely important that children learn to reason well. (Mrs. Thompson teaches a third grade class of 28 students. The school is in a mixed socio-economic neighborhood.)

In reviewing the reasoning section of the WRDC Mrs. Thompson noticed that the tasks were very conceptual and she thought that this would cause difficulties for some of her students. In discussing this with Mrs. Jones, Mrs. Thompson revealed that she would set lower standards of achievement for some of her students. When Mrs. Jones asked why, Mrs. Thompson's reply was, "... because some of my students are in a low socio-economic status."

Questions & Discussion Points (Possible answers are **underlined**)

1. What is the claim made by Mrs. Thompson?
   Very conceptual tasks are going to cause difficulty for some of her students.
2. On what ground(s) is this claim made by Mrs. Thompson?
   Some of her students are from a low SES group.
3. Supply a warrant that is being implied as the logical connector of the claim and grounds.
   Children from low SES do not perform well on conceptual tasks.
4. Create a categorical syllogism from the claim, grounds, and warrant.

   example
   Major Premise
   All children in low SES have difficulty with conceptual tasks.
   Minor Premise
   Some children in my class are from low SES.
   Conclusion
   Some children in my class are going to have difficulty with conceptual tasks.
5. What are some critical questions that need to be asked of Mrs. Thompson?
   (a) **"What is the generalization on which you conclude that your students of lower SES are going to have difficulty with conceptualization?"** (You are asking for a warrant or major premise such as the one created in #3.)
   (b) "What backing do you have to substantiate that generalization?"
   (c) "Is the backing reliable?"
   (d) "Are you assuming **all, some, most**, in your generalization?"

Further exercises

Suppose the scenario went like this:

In reviewing the reasoning strand, Mrs. Thompson sees that a certain area could cause difficulty with some of her students and she feels **that it would be more fair to set different standards of expectation for her low SES students.** On revealing this information to Mrs. Jones, Mrs. Thompson was asked why different standards would be employed.
Mrs. Thompson answered, "I know from experience that these children from low SES do less well on conceptual tasks."

1. What seems to be the key warrant guiding the actions of Mrs. Thompson?
   Fairness is a necessity in Mrs. Thompson's class
   (or other propositions having to do with fairness)
2. Create a chain of logical reasoning that would start with the warrant in #1 and end with the proposed decision of Mrs. Thompson to have different mastery levels. Symbolically the format of reasoning should be as follows where the statement "A is F" is being justified:

Conclusion A is F is justified:

because A is B(Warrant)
and B is C
and C is D
and D is E
and E is F
therefore A is F[7]

One possible chain:

1. The standards for the low SES students should be different (conclusion or claim) because
2. Mrs. Thompson's class is at unequal levels on conceptualization.
3. Fair classes are classes that have equal difficulty levels for all students.
4. Classes can **either** have equal **or** not equal levels of difficulty, not both.
5. Since Mrs. Thompson's class has different SES groups and since
6. Different SES groups have different levels of conceptualization ability, it follows that
7. Mrs. Thompson's class is at unequal levels of conceptualization.
8. Unequal levels of conceptualization would cause unequal levels of difficulty for members of Mrs. Thompson's class.
9. Therefore Mrs. Thompson would have to equalize levels of difficulty to make her class fair for all students.
10. Mrs. Thompson chooses to equalize difficulty for all levels of students by adjusting levels of mastery.

SCENARIO 4 (With explanations of answers)

Miss Darby decides to teach a unit titled **Where Is the Moon**. This unit, from the ESS curriculum, instructs children to observe the day and night sky and eventually predict the location of the moon. The ESS curriculum does not have behavioral objectives written for the teacher. Instead the philosophy is to provide a motivating activity for children (in this case grades 3 through 7) and allow the teacher the freedom to create her own objectives.

Miss Darby's unit objective is as follows:
"Given the activities of this unit the children will correctly predict the position of the moon when given the position of the sun and the phase of the moon." At the end of the unit, Miss Darby tested her children with the following multiple choice test.

1. The moon has this shape:
   Which of the following best describes its phase?

   a) Waxing crescent
   b) Waning crescent
   c) First quarter
   d) Last quarter
   e) Gibbous

2. The moon has this shape:
   Where would you look at it at sunset time?

   a) in the west
   b) in the east
   c) in the south
   d) in the north
   e) none of the above

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[7]Other ways of logically chaining propositions exist.

3. The moon has this shape:
At approximately what time would you see it in the southeast?

a) sunset
b) 9:00 p.m.
c) midnight
d) 3:00 a.m.
e) sunrise

4. The moon is in the south and has this shape:
What time is it?

a) sunset
b) midnight
c) sunrise

Exercises for students

1. Think of Miss Darby's objective as a conclusion and create a hypothesis (generalization) that Miss Darby is drawing from in order to make that conclusion. State the hypothesis in the **If A then B** format.
2. What backing exists for assuming that A causes B in the created hypothesis in #1?
3. Sort the backing in #2 into classes of statements that are either observations or inferences.
4. Given the table of Miss Darby's test results below create at least 3 conclusions concerning the validity of the hypothesis in #1.

Table 3
ITEM ANALYSIS OF 4 ITEMS

Item #	Correct Response	Individual Response		Class Average
		Correct	Incorrect	Correct Response
1	a	24	1	96%
2	c	21	4	84%
3	e	18	7	72%
4	b	17	8	68%
			Class average =	76%

5. Identify terms in Miss Darby's objectives that need to be operationally defined in order to ascertain whether Miss Darby was successful in achieving the objective.
6. (a) Create a behavioral objective (with terms defined) that would clarify the original objective of Miss Darby.
(b) Examine the test results and determine if your objective of 6(a) would have been achieved.
7. Create a hypothetical syllogism using the objective in 6(a) where the following format is met.

Major Premise: If A then B,
where A is the condition under which
B will be achieved.

Minor Premise: Select **one** of the following
A is observed,
A is not observed,
B is observed,
B is not observed.

Conclusion:	Draw an inference concerning either A or B.	
Example syllogism	If A then B	Major Premise
	not B	Minor Premise
	Not A	Conclusion

8. Critique the conclusion of #7 in terms of logic and reliability.
9. Show at least one invalid syllogistic form using Miss Darby's objective or your own (as in 6(a)).
10. Using some or all of the following concepts critique and discuss the test, premises, and conclusions of items 1-9.

Concepts

Observation	Objective vs. nonobjective observer
Inference	Cause and effect relationship
Faulty perception	Necessary or sufficient grounds/backing
Untested inference	Unwarranted vs. warranted generalizations
Invalid inference	Rebuttal possibilities
Uncorrobated observation	Variable control

Scenario 5 (with explanations of answers)

Mr. Hopkins, a tenth grade Biology teacher, has assigned several readings for supplementing the content of a chapter in the text. After two weeks of lecture and lab on the unit Mr. Hopkins asks Joe, a student in the class, to relate the readings to a principle that has been covered. Joe states that he has not done the readings.

Mr. Hopkins asks why and Joe responds, "This course is irrelevant and the work is just busy work. Why should I do your busy work?"

Exercises for students

1. Put Joe's statement into a syllogism and analyze the logic of the conclusion.

   One possible syllogism:

   Premise: No course of this type is a relevant course.
   Premise: All the work in a course of this type is busy work.
   Conclusion: Therefore, I should not have to do your busy work.

   Apparently, this does not logically connect. If we assume that there is a logical connection somehow embedded in the meaning of the language but not explicitly stated we would have Mr. Hopkins question the connection between the first two premises.

2. Create some plausible connecting propositions that link Joe's statements and create a chain of reasoning.

   One version of linkage might go as follows:

   All work that students are expected to do should be relevant work. (implied?)
   Relevant work is not busy work. (connection)
   The work in this course is not relevant. (stated explicitly)
   Therefore, the work in this course is busy work. (stated explicitly)
   And continuing
   Busy work is not to be expected of students. (Implied)

   I am a student. (obvious?)
   Therefore, I should not have to do busy work.

Presume some or all of these implications are thoughts that cross Mr. Hopkins's mind. He might try to reason with Joe by asking if the implied statements are actually used in Joe's reasoning, such as:

"Joe, are you implying that students should only be expected to do relevant work?"

OR

"Joe, do you believe that relevant work is not busy work?"

If Joe responds positively to either or both of the implied premises then the elements of the argument are in the open and discourse can proceed. If Joe responds negatively to the inferred premises then it is Joe's responsibility to illustrate his logical connections.

The statement, "The work in this course is busy work," is used as the first conclusion in the chain. For the moment assume the first three premises are accurate. Does the conclusion follow? Examine the logic of the first three premises and conclusion

Premise 1. "All work that students are expected to do (S.W.) should be relevant work." (R.W.)

Premise 2. "Relevant work is not busy work." (B.W.)

Premise 3. "The work in this course (T.C.) is not relevant." (R.W.) Since all work is either relevant or irrelevant, it follows that busy work (B.W.) is a subset of irrelevant work (I.W.) but is there overlap between T.C. and B.W.?

First conclusion: "The work in this course is busy work," **does not follow with certainty even if the premises are 100% true.**

It is up to Mr. Hopkins to point out to Joe that even if the course is irrelevant to Joe the work is not necessarily busy work. Of course Mr. Hopkins had better be ready to defend this last statement with a meaningful (to Joe) reason(s) why.

Even if the premises and conclusion would have turned out to be logically connected Mr. Hopkins should of course question all of Joe's premises. If the teacher cannot reason with a student who is using reasoning then the teacher has to resort to some sort of dogmatic statement such as "Do it because I said so," or "Just believe me Joe it's relevant" or "Yours is not to reason why." And it goes without saying that a teacher who is confronting a class that can reason is going to have trouble sooner or later with dogmatic statements.

The strongest attack for Mr. Hopkins is to question Joe on the implied premises and refute (if he can) any one or all in a reasonable way. But until those premises are clearly verbalized that cannot be done.

Scenario 6 (with explanations of answers)

Miss Dunn is a first year teacher and is teaching reading to first graders. One of her students. Jill, has annoying habits such as kicking the desk in front of her, fidgeting in her seat, and looking around the room incessantly. Also she is a very talkative child. These habits have been observed for a month and in Miss Dunn's words Jill is about to "drive her up the wall." Upon discussing this with the principal, Mrs. Clark, Miss Dunn finds out that Jill was diagnosed as hyperactive in kindergarten. This report was written by a school psychologist and somehow an administrative oversight occurred in failing to tell Miss Dunn of the condition of Jill. Miss Dunn on first hearing this was upset at the oversight but at the same time relieved. In her words, "I was blaming myself for not being able to hold Jill's attention when in fact Jill's attention could not have been held regardless of what I could have tried!"

The principal upon hearing this refuted Miss Dunn's statement with,

"Miss Dunn, never say 'a child **could not**',say 'she **will not**'! This opens up the door for continuing to try.

"Have you tried reinforcement procedures for Jill's behavior?"

"Of course," replied Miss Dunn. "I have a daily chart on which the problem students get a star if they are behaving correctly for the entire day. I also write the names on the board if incorrect behavior exists for that day. The name is erased when a star is awarded. So far, this

method has not changed Jill's behavior one iota! So either the reinforcement theory is incorrect or Jill cannot be changed!"

Mrs. Clark has been given a defense for Miss Dunn's conclusion that 'cannot' is the acceptable alternative. Either Mrs. Clark accepts this conclusion or she doesn't. How would Mrs. Clark begin a rebuttal of the position of the first year teacher? Two routes exist. She can examine the logic or she can examine the premises (or both).

The logic of the alternatives given by Miss Dunn are as follows:
Statement, **either A or B**, could mean two situations:

1. **A and B are the only alternatives possible**. If this condition is met then if A is denied B follows with certainity. This is the position that Mrs. Clark is led to believe. This type of syllogism is called **disjunctive** and A and B are called **contradictory** because A and B are mutually exclusive and exhaustive of all possibilities. An example of a contradictory proposition would be, **it is black or it is not black.**
2. **A and B are alternatives but not necessarily exhaustive.** These are named **contrary** propositions. Sometimes in reasoning through a problem we think we have disjunctive sets of possibilities when in fact we have overlooked other possibilities. As an example suppose you are examining a flashlight that doesn't show light when you turn on the switch. You may immediately theorize that either the batteries are dead or the lightbulb is burned out. Would you buy a new bulb if you tested the batteries and found them to be dead? Probably not. Your suspicions should continue to ramble to other possible problems such as, the connections are poor, the light is on but not perceivable under these conditions, or a combination of these factors.

   The point is in reasoning we sometimes argue from what we presume are mutually exclusive and **exhaustive** sets when in fact the sets may not be exhaustive of all possibilities. The procedures of arguing from contradictories and contraries is as follows:

Contradictory propositions	**Contrary** propositions
If A is denied then B follows with certainty (or vice versa). If A is accepted then B cannot exist.	If A is denied then B **perhaps** follows (not certain). If A is accepted then B **perhaps** does not exist.

Thus, one should always question the nature of the alternative. In the scenario above, if the reinforcement theory is incorrect alternative means of correcting Jill's behavior may be possible.

Another rebuttal possibility, and the one usually incorporated, is to check the premises for reliability. The first proposition of Miss Dunn concerning a reinforcement theory should be examined. First, one should ask for the cogent details of the theory. For example, the timing of the reinforcement that follows the behavior is usually shorter than the time that Miss Dunn incorporated. On this point alone one would have a potential rebuttal. In other words if a teacher is going to put accepted theories into practice she/he should have a clear **operational definition** of that theory. Operationalizing terms helps insure consistency in the language.

Exercises for students

1. Given the scenario above, write two claims (conclusions) that are stated and list the grounds and warrants of those claims.
2. Having produced a warrant for each claim written for objective #1, justify the warrant with backing.
3. Write a rebuttal for each claim written in #1.
4. Write Miss Dunn's final conclusion into a syllogism that illustrates her reasoning in arriving at that conclusion.
5. Critique the reasoning both for logic and reliability.
6. List at least five critical questions that would be necessary to ask Miss Dunn before one would accept or reject the final conclusion.

SUMMARY

This section of the book is designed to aid the college instructor in writing exercises for students that will facilitate critical reasoning. The examples are written for preservice education majors, but the procedures for constructing scenarios can be applied in other preparation sequences. The authors assume that the reasoner has had some experience in one or more models of teaching reasoning.

Three models are illustrated. They are: (a) The Process Model, (b) The Toulmin Model, and (c) The Syllogistic Model.

In addition, value clarification is presented as a correlation for the reasoning process.

APPENDIX D

ASSESSMENT OF CRITICAL THINKING IN EDUCATION MAJORS

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I. INFERENCES

Assume that all the information below is true. Examine each of the following inferences and circle on the answer sheet T, PT, ID, PF, F if you think the inference is true, probably true, insufficient data, probably false, or false. Use the following definitions for the quality placed on inferences:

T - If the inference is definitely true - that it **necessarily** follows from the facts given.

PT - Probably true - means better than an even chance of being true, base on information in scenario.

ID - You do not have enough data to call the **inference either true or false,** that is, the facts do not give you any basis for judging, or if alternate inferences can be drawn that equally rival the one given.

PF - There is better than an even chance the statement is false based on the information in the scenario.

F - This means the inference is definitely false - that is, wrong because it either **contradicts** the given facts or **misrepresents** the facts.

You are to use only the information in the scenario as the basis for your judgment.

Here is an example:

Joe scored in the top ten percent of his class (30 children) on an arithmetic test that measured skills of multiplication. Joe's class is taught by Mr. Smith, an experienced teacher.

A. Joe missed three problems on the test.
B. At least 27 children missed more problems than Joe.
C. Joe is in 1st grade.
D. Joe has had instruction in the past on adding and subtracting.
E. Mr. Smith is not Joe's teacher.

Answers:

A. **Insufficient Data** - There is no information that tells how many items were on the test.

B. **True** - If Joe is in the top ten percent of 30 children, it means that Joe is one of the top three students on this test. Therefore, it necessarily follows that at least 27 children scored below, i.e., missed more items on the test than Joe.

C. **Probably False** - Although it is not certain, there is better than an even chance he is in a higher grade level due to two facts; the subject is multiplication, and there are thirty children also involved in Joe's class.

D. **Probably True** - Multiplication skills are built upon addition skills and Joe probably had instruction in these skills. However, **it is not certain** due to other slight possibilities that Joe could have memorized math tables and not been in school, etc.

E. **False** - Mr. Smith is Joe's teacher. This necessarily follows from the fact that Joe is in the class of 30 and the class is taught by Mr. Smith.

Now continue as directed. Read the following scenario and place a value on each inference pertaining to the scenario.

Imagine yourself in the following situation: This is your first year at P.S. 1106. The setting is a 4th grade classroom of 26 children. It is the third week of school and you are just getting your rapport and discipline established to the point that the children know what is expected of them. The time

is early afternoon and you are going over some math papers with each student while others are busy on worksheets. John's arithmetic score is five out of ten correct and at this time you call him forward to find out why he is making mistakes that no one else is making. You have also been starting to notice that John does not catch on as fast as the others, and you are speculating on the reason. Other information available indicates that John is reading at a second grade level. You also have noticed an unusual amount of teasing by other children directed at him and on three occasions have caught him crying quietly. Your primary goal is to educate John in a variety of subjects but you are starting to hypothesize that other steps may be necessary in order to help him with his lessons. You have previously heard the third grade teacher, Miss Jones, make the statement, "John acts like he is spoiled at home and he cries a lot to get attention."

1. John is over eight years of age.
2. You are a new teacher.
3. John scored at least 10 percent on the arithmetic test.
4. John's score is lower than the rest of the class.
5. You are a first year teacher at this school.
6. Children seem to tease John more than other individuals.
7. John is spoiled at home.
8. John does not do as well on his subjects as the other children in his class.
9. John is emotionally disturbed.
10. John has a lower than average I.Q.
11. If John gets more attention he will not cry as much.
12. Students in this classroom get individual attention.
13. John has been in Ms. Jones's third grade class.
14. John has home problems.
15. The setting occurs in September.
16. John is a discipline problem.
17. You are teaching in a rural school.
18. You are teaching in a large school.
19. John shows more home neglect than the other children.
20. John has reading difficulty.

II. GENERATING AND TESTING VALID INFERENCES

Suppose the following math paper is John's. Examine it and then correct for errors. After scoring the paper, create two inferences that possibly explain why John is making mistakes. (There may be many inferences.)

1. 236 − 129 117	2. 263 − 171 192	3. 72 × 27 504 144 648	4. 72 × 7 504	5. 425 − 362 163
6. 325 × 27 2275 650 2925	7. 249 + 136 385	8. 46 21 + 35 102	9. 137 × 5 685	10. 748 − 327 421

Write two **valid** inferences concerning the cause(s) of John's mistakes on his math paper. For purposes of this test, a valid inference will be met by the following conditions:

1. There is more than one piece of data in support of it.
2. There are no data that deny it.

Inference A

Inference B

III. **TESTING INFERENCES**

How would you test your inferences? In the following space create a situation that would test each valid inference (and no others).

Inference A Test

Inference B Test

IV. **RECOGNIZING ASSUMPTIONS**

In arguing a point of view people usually do not state in full the premises or even, in some cases, the conclusion. The listener has to decide what is being implied in order to follow the reasoning of the speaker. In the following exercises you are to read each paragraph and then select from a set of alternative assumptions the one that can best be inferred from the paragraph. In other words, you are looking for the assumption that is being implied by the speaker.

Here is an example:

"After giving John fifteen additional math fact questions I've decided that he can't hear well because he is missing the ones that I recite to him." What is the speaker implying?

A. John is correct on questions that he can read.
B. Other children in the class are not hard of hearing.
C. John doesn't know his math facts.
D. The teacher has tested other children.

Be sure to read each paragraph independently of the other paragraphs.

1. "John has to be given directions over and over again and still he can't follow directions. I believe he has some form of retardation."
   A. John can't follow directions.
   B. John can't hear the directions.
   C. Not following directions is a trait of retardation.
   D. Not following directions indicates John doesn't understand the language of the directions.
2. "John has emotional problems because I've seen him crying a lot."
   A. Crying can be causation for emotional problems.
   B. Crying may or may not be indicative of emotional problems.
   D. Children who are emotionally disturbed will be seen crying at times.
3. "If I give John more attention his crying spells will diminish."
   A. John has not been given enough attention.
   B. John has a poor home environment.
   C. John could have another problem that is reflected in his crying.
   D. John's problem is caused by too much attention.
4. "John is shorter than any child in the classroom and this is giving him an inferiority complex."
   A. Shorter people are more aggressive than taller people.
   B. Taller people do not have inferiority complexes.
   C. Taller people have inferiority complexes also.
   D. The smallest children are likely to have inferiority complexes.
5. "John might have a vision problem because he squints his eyes when looking at distant objects."

A. Squinting the eyes is an indication of things other than poor eyesight.
B. Anyone who squints his eyes is trying to see better.
C. The lighting condition is too bright.
D. Squinting one's eyes causes poor eyesight.

6. "Since half the children in my class are below state averages in arithmetic John is more typical of children in this class."
   A. John should be doing better.
   B. John is at a level that reflects the ability of this class.
   C. Both A and B are assumed.
   D. Neither A nor B is assumed.
7. "Even my minority students don't have the problems John seems to have."
   A. Minority students have more problems than usual.
   B. John is not a minority student.
   C. Both A and B are assumed.
   D. Neither A nor B is assumed.
8. "Miss Jones (the third grade teacher) has indicated that John is seeking attention and she is probably correct. I didn't think of this before."
   A. Miss Jones is an authority on John's behavior.
   B. Miss Jones doesn't know what she is talking about.
   C. Both A and B are assumed.
   D. Neither A nor B is assumed.
9. "Most of these children come from poor families because they aren't dressed well."
   A. Poor families do not have enough money to dress their children well.
   B. Children who are not dressed well come from poor families.
   C. There can be other reasons for children not dressing well.
   D. All the above are assumed.
10. "If I am consistent with my discipline I can stop the other children from teasing John and John's crying will decrease."
    A. John's crying is caused by teasing.
    B. One needs consistent discipline in order to change behavior.
    C. Both A and B are assumed.
    D. Neither A nor B is assumed.

V. INTERPRETING RELIABILITY

Assume the following experimental results have been performed. The experiment is mythical but for the purposes of this test **you are to regard the information given as being accurate.**

Ms. Darney and Ms. Klein are on the textbook review committee for the purpose of deciding which K-6 science curriculum should be adopted for their school district (Pleasantville). Recent science test scores indicate that Pleasantville fourth graders scored well below average when compared to the state average, especially on "process" items. In order to make an informed decision Ms. Darney has done a research review and has discovered a doctoral research experiment involving 4th graders from their district. The experiment was done to determine if there were any differences in process skills of children who received two different approaches to science instruction.

The subject taught was "relative position and motion." The two fourth grade classrooms were combined and then randomly split into two groups of twenty-four children each. The two approaches were labeled (a) "activity oriented," and (b) "non-activity oriented text approach." The same teacher taught both groups. The measurement used was a fifty point multiple choice written test assessing the process "using space-time relationships." The following chart summarized the experiment.

	NUMBER	TEST AVERAGE RAW SCORE OUT OF 50
ACT. APPROACH BOYS	11	35.4
GIRLS	13	37.6
TOTALS	24	36.6
NON-ACT. APPROACH BOYS	11	32.7
GIRLS	13	38.2
TOTALS	48	35.9

The researcher drew this conclusion (among others):

THE ACTIVITY APPROACH WAS THE BETTER METHOD FOR TEACHING PROCESS SKILLS.

Each of the items from 1 to 4 contains two underlined statements. You are to decide if one of the statements is more reliable than the other. If you decide that the statements are equally reliable (or unreliable) mark **neither.** Code: A-is probably more reliable. B-is probably more reliable. C-neither is probably more reliable than the other.

1. A. **Boys had a lower score than girls.**
   B. **Girls have the better ability to understand concepts of space/time relationships.**
   C. Neither
2. A. **Activity oriented science was better than non-activity science for students to understand science.**
   B. **Girls' better scores are due to their ability to verbalize concepts better than boys.**
   C. Neither
3. A. **"Activity oriented science is the better approach to teaching science"** (quote from a publisher of an activity oriented science curriculum).
   B. **"The results do not indicate which approach is better."** (quote from a non-activity/reading program text publisher).
   C. Neither

Using the same data chart and experiment mark the following items according to this code.

A. If true, makes the researcher's conclusion more certain.
B. If true, makes the researcher's conclusion less certain.
C. It would do neither.

Treat each item independently of the others.

4. The experiment is done again but with different children. The results are similar.
5. The experiment is repeated but with different children and a different teacher. Score = 38 ACT. ORIENTED; 39 NON-ACTIVITY ORIENTED.

6. A new researcher tests the concepts with live demonstrations and films instead of paper-pencil tests. Score = 41 ACT.ORIENTED; 32 NON-ACTIVITY ORIENTED.
7. A different researcher gives a pretest to each group and finds that boys and girls have roughly the same score but the totals turn out as follows.

	PRE-TEST	POST-TEST
ACT. APP	23.2	36.5
NON-ACT. APP.	26.7	35.9

8. An interview with the classroom teacher prior to the research discloses that he is an avid fan of the inquiry/discovery approach to education.
9. It was discovered after the experiment that girls' reading scores were higher (tested in 3rd grade) than the boys' scores.
10. A replication of the experiment was conducted with pre-testing and post-testing; random assignment of children to groups; non-written test; with following results.

	PRE-TEST	POST-TEST
ACTIVITY APPROACH	32	36
NON-ACTIVITY APPROACH	33	34

VI. DEDUCTION

Directions — Read the following paragraph of facts and assume them to be true. After the paragraph of facts you will find several inferences stated as conclusions that either follow or do not follow. If you think the conclusion necessarily follows from the paragraph, mark it **conclusion follows.** If you think the statement is not a necessary conclusion from the paragraph indicate it as **not following.**

Ms. Jones is a substitute teacher who has been asked to teach Ms. Miller's 6th grade class. Upon arriving at school she finds the plan book lacking in detail, especially in regard to a unit on American History entitled, "The Early Presidents." The reference in Ms. Miller's plan book simply states, "review text material pp. 47-159." Ms. Jones decides to ask simple questions at first in order to build a rapport with students. Her first question is, "Who was our first American President?" No hands are raised and no student volunteers the answer. Ms. Jones speculates on reasons why she hasn't received any response.

Her first hypothesis is that **if the students don't answer a simple question then they don't know the material.** (Assume this to be true.)

The students were asked a simple question and didn't answer. Then according to the stated hypothesis,

Conclusions

1. The students don't know the material. CF NF
2. The students know the material but are too shy to answer. CF NF

If there is response from only one student then according to the hypothesis,

Conclusions:

3. The students don't know the material. CF NF
4. The students know the material but are too shy to answer. CF NF
5. Some of the students know the material. CF NF

Continue in similar manner.

Hypothesis: **If children are in the presence of a new teacher they will not want to respond to her. Assume this to be true and disregard the previous hypothesis.**

Observation: David is a member of Ms. Jones's class.

Therefore:

6.	David does not want to respond to her.	CF	NF
7.	David cannot respond to her.	CF	NF
8.	David is too shy to respond to her.	CF	NF

Hypothesis: **"If the children don't respond then I don't have my rapport built yet."**
(Assume this to be true and disregard the former hypotheses)
Observation: The children responded.

9.	Ms. Jones established her rapport.	CF	NF

Observation: The children did not respond.

10.	Ms. Jones has not established her rapport.	CF	NF

APPENDIX E

STRATEGIES FOR HEIGHTENING STUDENTS' REASONING SKILLS

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Since 1980, about 20 faculty members have taught the freshman course, "Introduction to Liberal Studies." Initially, the course created more conflict between faculty members and students than any other course in the first-year curriculum. The degree of conflict varied with the instructor or instructional team and manifested itself in the students' evaluations of the course and/or instructors. Subsequent insights into the reasons for the discord led to the development of several strategies which have been used successfully to improve faculty-student interactions and to increase the students' capacities for reasoning. These strategies are discussed in this paper.

Each year, the freshman class is divided among three sections, each taught by a team of three faculty members. The latter are selected because they have histories of excellent rapport with students and are perceived by the dean of students to be excellent teachers. Each section addresses the same four main areas: critical reasoning skills, modes of knowing, values clarification, and creative life planning. Inasmuch as the instructors have different backgrounds, the manner in which these goals are achieved vary from section to section. The purpose of the course is to help students to improve their reasoning skills by the application of reasoning processes to speaking and writing. Various topics are introduced for the students to argue about, question, and reason. The variety permits students to consider differences in modes of reasoning. Values clarification is used as a specific application of the students' critical reasoning skills.

When the faculty-student discord first surfaced, the different teams, and mine especially, sought the causes. Did they lie in poor instruction? inadequate preparation of faculty members? immature students? What elements in the courses caused so much conflict? Given 20-20 hindsight, I can now report my observations and inferences regarding this conflict and show the applicability of the Perry Development Positions to the questions.

The general strategies used to teach this course are perceived by the freshmen to differ from the strategies to which they were exposed in high school. The discussion of several strategies in terms of their merit or difficulty illustrates the differences.

After receiving instruction on fallacious reasoning, the students were given reading materials that reflected some form of argumentation and then assigned the writing of a paper in which they were to analyze the argument. They had been told a possibility existed that a number of answers might be both appropriate and correct. Many students were disturbed by the idea of divergent answers. They voiced the opinion that there should be a unique answer—only one possible answer—and all others should be incorrect. This position is the first on Perry's Development Chart—the dualistic; it is frequent among college freshmen.

The dualistic mode of reasoning is found especially when exercises do not have specific answers. In discussing the critiques of and answers to the exercises in the course, the faculty members reported that certain key phrases tended to make students feel uncomfortable, particularly a response such as, "Yes, that could also be considered correct" or "Let me think about that for a moment." Students tended to react negatively to the instructor's "failure" to know the answers.

This syndrome usually reared its head in discussions of test answers. Inasmuch as the English language can convey a diversity of meaning from a unique phrase, students were sometimes perplexed when arguments elicited a variety of interpretations from other students. We found out

very quickly that when administering and grading a test in which multiple responses were possible depending on the context, a special technique alleviated classroom problems, this technique is as follows:

Have at least one faculty member other than the test writer read and interpret the question in as many ways as possible to create the most acceptable answer key. Grade the students' answers using this key.

On the day the tests are returned, announce to the class that many other answers may be possible depending on individual interpretations. Do not, however, permit students to ask publicly if their interpretations can be considered correct. This step is important. It prevents students who have similar answers for the wrong reasons to "shirt-tail" a student who can give a sound reason for her (his) answer. Because the situation may get out of hand, the instructor must offer other options.

Set aside 10 minutes of the class time so that those students who have what they consider to be appropriate responses or appropriate defenses for responses which have been marked "incorrect" may write a brief justification of their particular interpretations/defenses. Announce, at the end of the 10 minutes, that students may present oral defenses of their positions on a one-to-one basis before the instructor within the week. Then collect all the papers. Inform students that they will be expected to stick to the argument of the synopsis at the oral defense.

Those instructors who have tried this method of test review all agree that it makes students and faculty members more comfortable than an open forum on test answers. Practically, if an instructor were to spend class time justifying her/his own interpretation of test answers, less than 10 per cent of the students would probably sign up for an appointment. Students also perceive this technique as fair and reasonable because they know they can be heard, especially when they find out via the grapevine that some students actually have been successful in defending answers.

Another technique that we found to be efficacious in getting over the dualism problem is to break in the student gradually to *divergence*. Here is an example of our technique:

On the first homework assignment that tests reasoning we give the students a simple problem with direct answers, and we give each student a copy of the answers. The next day we discuss the answers.

On the second assignment we cover the same concept but we do not give out answers until all papers are returned. Then we discuss the assignment.

On the third and final attempt to practice the concepts, we do not give any answers to students. We let them discuss answers in small groups and to reach a consensus, then the groups are told to compare their answers. This practice enables instrumental autonomy to be fostered whereby the instructor gradually withdraws his/her posture as the authority.

We find that at least two attempts at this gradual approach are necessary before we can expect students to be self-reliant. After all, real life up to this point for freshmen typically has been one of accepting external authority, so to rush in and expect them to make autonomous decisions is analogous to throwing non-swimmers into the deep water, some will swim but the chance of losing others is very high.

Once, several years ago, when I was team teaching the course, we happened upon a technique that enable students to overcome their excessive dependencies on authorities to tell them what is correct. The students were given a reading assignment, "On Messages of Distance and Location" by Flora Davis, to criticize. The main thesis of the article is that interactive distance between conversing adults is tied to culture, degree of acquaintance, and other variables. We showed a videotape of the students getting acquainted on the first day of class. All were standing, the desks pushed out of the way. We asked the students whether the videotaped scene supported or denied the Davis theme. Then we separated into three groups and sent each to a different room with an instructor. By prior arrangement each instructor (for convenience, let us call them A, B, and C) agreed to bias the students' opinions very indirectly by nonverbal expressions or by positive responses, according to the instructor's unstated position. Instructor A was to bias in favor of the videotape and to show strong support for the article, instructor B was to take the opposite position; and instructor C was to be noncommittal.

When we brought the groups back to the main classroom we asked them to shut their eyes and to vote by a show of hands on what they had agreed upon: favoring support, denying support, or "too close to call." By asking the students to shut their eyes we were able to preserve anonymity for each group's position and to save the time that written ballots would take.

The results for each group showed a very high correlation with the instructor's cues. The class was interested in the point that was made. Later, students wrote in their class journals that the episode was a turning point for them in regard to autonomy and maturity.

We tried this technique with other groups and other subject matter with the same results. After the experience the students become more aggressive in stating their own opinions and defending them. The trial usually should occur sometime in the third to fifth week of the quarter. This is the time when freshmen—at least, ours—seem to be more relaxed about their abilities and chances for success in college and less anxious about being duped.

To get students to move on to more advanced thinking (multiplistic and relativistic stages of Perry's scheme) we have used the following strategies. However, it has only been since 1980 that we faculty members have been aware that Perry classified for us the characteristics covered by his terms.

Anyone experienced in teaching undergraduates knows that when students are confronted with difficult value-laden exercises they have a tendency to respond with such statements as "Everyone is entitled to her own opinion." This phrase seems to justify for them a curtailment of whatever discussion is at hand. In order to alleviate that problem I use the concept of relativity in the scientific sense to introduce the need for reference-framing in analyses of arguments. Relativity and frame of reference are then applied to non-science areas, such as the arts, and finally to values clarification. With this procedure the students begin searching for contextual characteristics in learning how to make judgments of right and wrong.

I begin the course unit on relativity with an overview of Galileo's ideas and of Einsteinian Relativity. This strategy seems to open up the students' minds to the diversity of "correct answers" that can be obtained by changing the frame of reference. We then move into analyzing the various debatable issues in art by modeling three frames of reference: technical issues, interpretive issues, and theoretical issues. In all types of analyses the debate centers on defining the claim, grounds warrants for relationship of ground to claim, backing for the warrant, and exceptions to the rules—the rebuttals. This model of analysis is taken from the textbook we now use (Toulmin et al., 1979, *An Introduction to Reasoning*; see Appendix G).

Finally, the relativity frame of reference is applied to values clarification. For this we present a model similar to the one formulated by Raths, Harmin, and Simon (1966). We also use moral dilemma as a resource for debating and analyzing issues. The result of these activities is that the students tend to cease using phrases such as "Everyone is entitled to her own opinion" to curtail discussion and move into positions closer to "Why do you feel that way?"

As a culminating activity for this unit we have the students apply their reasoning techniques to a project very meaningful to them—a review and analysis (or, sometimes, synthesis) of their career choices. The project is planned with the aid of the Student Development Council or whoever supervises the project for us. Students have told us through their class journals that they consider the experience very worthwhile.

The strategies described in this paper are basically those that were used by the team of which I was a member. Some of the techniques, however, also have been tried in other sections with a degree of success that encourages us to continue using them. Not all strategies have been used during any one term but they have been developed and put to use as the course has evolved. We have documentation that the student perception of the course has continued to be favorable. Each year, the course ratings continue to improve to the point that the ratings now challenge the high positive ratings in our other courses. Of course, other variables could account for some of this positive growth but I feel that our increased knowledge of the intellectual and ethical development of college students has accounted for a significant degree of that change.

In the next section of the course which I shall teach I plan on using some of Perry's work as

reading material for the class. I assume that the students will gain a better perspective on our ways and means of instruction, which will facilitate their movement to more advanced development positions.

APPENDIX F

CRITICAL REASONING AND COLLEGE WRITING PROGRAMS: A CASE HISTORY AND A MODEST PROPOSAL

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The developments in the College of Saint Teresa's curriculum over the past decade have not occurred in a vacuum, in certain significant ways, some of these developments, especially the emphasis on the teaching of critical thinking skills, coincide with major national trends, at least in the area with which I am most familiar—the teaching of writing. In this paper I examine the nature and significance of these developments in three of their aspects: (1) the implications for writing programs with the new stress on critical thinking; (2) the actual impact of the new developments upon writing instruction at CST; and (3) the kinds of developments that have not yet occurred but seem possible and desirable in the light of present goals and expectations in the new curricula.

Persons outside the field of writing instruction, sometimes even those in college English departments, are frequently surprised to learn that the last two decades have been a period of unprecedented research and development in the teaching of all aspects of writing. Certainly the teaching of writing does not much resemble what it was when I entered the profession in 1964. The job of the teacher of writing then was conceived to be much what the average lay person still believes it to be: to detect and correct errors of grammar and usage; to encourage the imitation of a few rigid structural models for the organization of essays; and to grade the final product on the basis of these and similar criteria. These concerns have not, of course, disappeared or become unimportant; it is just that the developments of the past decade have placed them in a much larger context, one in which the writing **process**, rather than some idealized and frequently unrealistic **product**, has become the prime focus of instruction; newer textbooks now stress matters that were not mentioned at all in the books of a decade or two past: rhetorical invention, voices and audience, techniques of controlling style, such as imitation and sentence combining; and generative rhetoric, to name some of the more common ones. Recent research on the relation of writing and cognitive development is already sizable (e.g., for a good overview and introduction, see Irmscher, 1979); it has turned up a variety of relations between the developent of cognitive processes and the use of language that have given impetus to a stress on writing as a means of enabling students to become more able thinkers and reasoners. This latter concern is one of the newer developments and has only in the past few years begun to attract the kind of investigation needed to place instructional methods on a firm theoretical foundation. It is also one that has a special significance for CST's curriculum.

Traditionally, "critical thinking," when addressed at all in writing courses, has been treated under the rhetorical categories of deduction and induction—often presented in older textbooks as coordinate with other rhetorical modes such as definition, classification, comparison/contrast, description, and so on. In practice, however, whereas most instructors were moderately comfortable teaching students to write paragraphs or essays using these standard techniques of development, few felt anything like the same confidence when it came to handling logic—induction and deduction. One of my strongest memories as a young instructor is the reported spectacle of a colleague making a fool of himself in a losing argument with a student over a number series (one of the examples of inductive reasoning in the text we were all using). The problem was not, of course, that we were incapable of teaching such material (although some obviously were), but that the subject was too complex for inclusion in a one- or two-week unit of writing course. Moreover, it was by no means evident that a 3- to 6-hour minicourse in the categorical syllogism and J. S. Mill's canons of induction had any practical benefits for actual student writing. The result

was that, increasingly, textbooks tended to leave the development of critical reasoning of this type to the philosophy department and its logic instructor, despite the obvious fact that only a small minority of students would ever take advantage of these opportunities.

Against this background, then, it was with considerable interest that I observed (and participated in) the development of a freshman-level introductory course in critical thinking: "Introduction to Liberal Studies." In effect what I saw was the assumption by a separate academic division of an important but neglected area of traditional rhetoric. Having long since abandoned any pretense at covering formal logic in my own writing courses, I was curious to see what would happen when a universal requirement in this area became a standard part of the curriculum. Presumably, the courses would, by strengthening critical thinking skills, produce an increase in the quality of reasoning in student writing. The actual results, in the earlier phases of the program, insofar as I can judge from my experience and that of others who teach writing, were less dramatic. It now appears that the kind of traditional, formalized logic stressed in the early years of our new curriculum had little practical effect, despite the strenuous efforts of the faculty who planned and taught the course. Even in the larger confines of a course committed to the development of critical thinking skills, it was not possible to do justice to this traditional material (the course also had, and still has, as major objectives the teaching of values clarification, "modes of knowing," and career/life planning, objectives which some of us felt were excessively ambitious for a 10-week course), the uncertainties and insecurities of all but the most thoroughly trained instructors were brought to the fore in the treatment of the categorical syllogism and attendant topics. As one instructor expressed it, when it came to formal logic he felt a bit like the Platte River: a mile wide and an inch deep.

It is hardly surprising that the students saw little value in this aspect of the course, though a few, after the course was over, professed to see some benefits of a general nature. The widespread dissatisfaction of instructors and students alike led to a significant change in the approach and emphasis in the course during the 1982-83 academic year. Previous to this time, all instructors had worked from uniform texts on critical reasoning, with a change of text after the first two years (1980-81). In the spring of 1982, however, the instructors agreed what was really needed and practical as a course objective for this "Introduction to Liberal Studies" was an emphasis not on formal, deductive logic, but on less formal, more practical, inductively oriented reasoning of the kind required in the understanding and evaluation of ordinary academic and practical discourse. Accordingly, it was agreed to adopt a text that departs radically from the traditional procedures of instruction in this area—**An Introduction to Reasoning** by Toulmin, Rieke, and Janik (1979). Most of the instructors had considerable misgivings, at the outset, because given the nontraditional terminology and flow-chart diagrams in the text it appears forbiddingly complex at first glance. Upon closer acquaintance, however, it became apparent that in fact this text addressed the problem of developing student reasoning skills at a much more fundamental level than any other text we had come across. Even the traditional information fallacies (**argumentum ad hominem, ad baculum**, etc.) are not covered until well into the second half of the text, and the categorical syllogism is not treated at all.

Before I tout the virtues of Toulmin I should say, in fairness, that there is considerable, though not conclusive, evidence that the instruction along traditional lines in the earlier offerings of the course was effective in increasing critical thinking abilities, at least insofar as these skills can be measured by the Watson-Glaser Test of Critical Reasoning. Average gains of 8 to 10 percentile points were recorded in one of the early pre- and post-course measurements, and I was impressed, during the last quarter I taught the traditional material, by some of the extraordinary rises in the scores of better students (sometimes by as much as 30 percentile points). By these standards, the early experiment was at least a qualified success and was recognized as such at the time. From the writing instructor's point of view, however, the effects of the program were less remarkable. The critical thinking unit in "Introduction to Liberal Studies" seemed to have had little impact on the mushy, poorly supported, weakly articulated reasoning manifested in the average freshman essay. The reasons for this state of affairs must, in the absence of rigorously

conducted studies, remain on the level of conjecture; I believe, however, that some judicious speculation might well cast some light on the causes of this failure.

There are, I believe, two reasons why conventional instruction in logic fails to show any beneficial effects on student writing: (a) Anyone who has spent much time analyzing the kinds of reasoning problems typically associated with writing of any kind, even student writing, will have noted how rarely one encounters formal fallacies of any kind, and how frequently student writing suffers from other, less clear-cut kinds of "logical" problems. Shaky evidence, irrelevant evidence, misunderstood or poorly described evidence are more common than affirmations of the consequent or denials of the antecedent. Even the standard recognized informal fallacies—appeal to the masses, **argumentum ad hominem**, etc.—though certainly more common than the formal fallacies, are less frequent than most people think. (b) Even when these reasoning techniques are taught, the grasp of the average student (especially in the case of the hypothetical and categorical syllogisms) is so slippery that it is useless as a tool of analysis. One of the more dismaying experiences in teaching the course was the discovery that the use of Venn diagrams, ostensibly a tool for clarifying tricky syllogisms, actually seemed to obfuscate the issues in question, the Venn techniques seemingly placing greater demands on the student's powers than the problems themselves.

The problem, in brief, is that although instruction in logic very likely has benefits for general intellectual development, its more immediate value to student writing is doubtful and probably minimal. Out and out illogic in student writing is not the main problem.

What, then, is the main problem? In my experience it is the difficulty a great many, perhaps most, students have in shaping and fitting together the pieces of fact, opinion, and observation into a connected and convincing whole—a **logically** connected whole, I nearly wrote. Logical, yes, but in the more general sense of understanding and explaining just how the evidence marshalled in support of a thesis does in fact support that thesis. And although a great deal has been written in traditional and contemporary rhetoric books on how this is done, there seems to have been little progress in devising a systematic procedure for helping inexperienced writers to build a reasoned structure into their work.

Enter the system advanced by Toulmin and his associates. Their's is a six-step system of argument: the writer makes a **claim**; offers **grounds**, i.e., facts, to support it; demonstrates that there is **warrant** for connecting ground to claim; shows (at least implicitly) that there is **backing** (theoretical or experimental foundations) for these warrants; qualifies the claim with the appropriate **modal qualifiers**; and considers possible **rebuttals** to his/her case. Truth to tell, Toulmin has been slow to catch on among teachers of writing (possibly because the teaching of logic has fallen into such disrepute) although some notable efforts have been made to adapt the basic scheme to various writing tasks (e.g., J. Hays, "The Development of Analytic Writing Abilities: A Preliminary Report"; J.F. Stratman, "Teaching Written Argument: The Significance of Toulmin's Layout for Sentence-Combining," **College English**, November 1982, 718-733).

At least four things are plain when we look at Toulmin's model: (a) It bears little resemblance to the conventional treatment of argument, either in terminology or in sequential arrangement. (b) The language of the system, although not that of traditional logic, is in fact very close to the language used in everyday speech to describe argumentative strategies (though of course Toulmin defines each term in a manner that rules out some colloquial meanings); the sole exception is the term **modal qualifier** (used to describe limiting terms such as "some," "most," "probably," and so on), which, fortunately, is one of the easier concepts in Toulmin's system. This second point I believe to be one of the strongest recommendations of the method: it is crucial, it seems to me, to make the students see that the language of reason **is**—or ought to be—the language of everyday life, in all of its complexity and untidiness. Certainly such familiarity is an enormous advantage in communicating the basic elements of argumentative strategy to students. (c) This language, for all its familiarity, is not, for the most part, the language of traditional rhetorical instruction in argumentation, either. Of this, more presently. (d) Upon closer acquaintance with Toulmin's book, the reader will find that in the sample arguments analyzed in these terms, no incontestably right

or wrong answers are either sought or given. Students may be brought to see that the grounds for a claim are "slim" or "shaky," that the theoretical backing is absent or of dubious relevance, but not that the argument is "false" or "invalid." What the student does learn is that the plausibility of the claim is dependent upon a set of relations that can be extended and analyzed in a systematic although not necessarily conclusive fashion.

All of this, it seems to me, is highly relevant to the teacher of writing who is seldom concerned with judging students' writing as true or false but very much concerned with helping to strengthen and clarify the underpinnings of their arguments. Time and again over the past two years I have found myself telling students not the usual "You need better support for your thesis," but, "You need stronger **grounds** to support these **claims** you're making." I feel comfortable in doing so, not only because, in most instances, I can assume that the student has spent 10 full weeks getting acquainted with these terms but, also, because I know that I am speaking the language of ordinary educated men and women in their daily transactions. Mention the term "thesis" and you are likely to get a wrinkled brow or a groan (that old English-class jargon again), but everybody knows what a **claim** is. I even believe that there is some value in the slightly pejorative ethical connotations of the term: when someone makes a "claim," it's assumed by most of us that evidence will be required if it is to be taken seriously. That, it seems to me, is the right strategic tone to adopt when discussing a student's trial thesis or first draft in conference: "You've made some interesting **claims** here, but are they **warranted**? What are your **grounds**?"

Has the new approach begun to show results in the writing classes? One of my English Program colleagues assures me that she finds her students much more sophisticated in the handling of arguments than in former years. I wish I could heartily endorse her impressions, but years of reading writing teachers' extravagent claims for the success of one or another new approach have made me cautious. Let me say merely that with a more concerted effort across the curriculum a real difference **could** result. And I am optimistic about the chances of this happening for a number of reasons, some of which I have already addressed.

1. The Toulmin terminology, as I have noted, with one or two exceptions is familiar to ordinary discourse and requires no elaborate learning of a new system or recasting of an old one, merely a shift in emphasis.
2. The informality of Toulmin, once the initial appearance of complexity is dissipated, is nonthreatening and lends itself well to most disciplines.
3. Toulmin's relativistic approach with respect to concepts of validity and invalidity, truth and falsehood, corresponds more closely to the kind of thinking that most of us, either consciously or unconsciously, are trying to encourage in students. This phenomenon has been extensively studied by Perry (1970).

Whether, as in my section of Introduction to Liberal Studies, the students are debating the merits of the sociobiological view of human aggression or, as in a colleague's section, considering the conflicting claims of opposing sides in the Central American crisis, they are certain to emerge with the knowledge that questions of serious concern to our moral, intellectual, and political life are usually complex and not susceptible to simple true/false solutions. Even the discovery of an obvious logical contradiction is not going to resolve such an argument definitively, and we do students no service when we imply, in overstressing syllogistic logic, hat it will. What **can** be done is to examine, analyze, and weigh the various parts of an argument, discovering its component parts and forming a general picture of the argumentative strategy being employed. If the students reach the point where they can, with confidence, say that an argument is **relatively** strong or **relatively** weak, we will have accomplished a significant goal. If we can get them to evaluate their own written arguments in the same manner, and to revise them accordingly, we will have brought them to the threshold of the world of mature written discourse.

The experienced teacher of writing—especially, of course, the English or rhetoric instructor—will immediately see that the Toulmin approach provides a powerful enhancement and extension of the conventional thesis-support model of argumentative structure, especially in its stress on warrants and backing, areas that seldom receive systematic treatment in the typical freshman

English course or text. I believe, however, that for this approach to yield its full potential instructors in other fields must adopt its methods, terminology, and attitudes in assigning, discussing, and evaluating written assignments. If the recommended model involved a wholly novel set of terms and concepts, this would, of course, be an immoderate request; since, however, as I have argued above, the Toulmin model is to a great extent a systematic and precise use of words and concepts already familiar to most educated people, the adjustment would require only moderate shifts of terminology and method for most fields. It should not require a major effort for the history instructor to advise the student writing on the failure of the Roman republic to find more relevant and stronger **grounds** for the contention that Gracchan reforms were the cause; for the psychology instructor to suggest that a term paper on the function of dreams needs stronger theoretical **backing**, for the sociology instructor to advise the young analyst of the causes of child abuse to **qualify** her conclusions; or for the American literature instructor to remind the enthusiastic admirer of Hemingway to anticipate possible **rebuttals** to his argument that the Hemingway "code" is a complete guide to life.

The practical question of how to achieve this consensus of logical language need not detain us long. For the small college, perhaps the best solution lies in the general nature of the introductory-level course in critical reasoning. At the College of Saint Teresa, after an initial experimental period in which a comparatively small number of instructors were involved in teaching the course, a rotation of instructors, which ultimately will involve a sizable percentage of the whole faculty, is already underway. For the larger institution, a series of workshops and colloquia on the general topic of writing-across-the curriculum, with follow-up activities coordinated by the directors of the writing and freshman studies programs, would be the most likely vehicle for disseminating the Toulmin model.

The benefits of such a unified effort, not the least of which would be the promise of a remedy for the near-anarchy that has prevailed in the liberal curriculum for the last 20 years, would be substantial. The innovations of these past two decades, laudable as many of them have been, must, if they are to have any ultimate value in the actual practice of education, be fitted into a new consensus of what a liberal education is. There is, it seems, much to be said in favor of a greater effort in the direction of a common language of reason—a language that, as I have noted, we are, to some extent, already speaking—which would unite the various disciplines in this enterprise we call liberal education.

APPENDIX G
THE TOULMIN MODEL*

The Toulmin Model (of Communication)

In order to facilitate communication on higher order skills across departments and faculties, it is essential that a generic terminology be used. The Toulmin Model, which uses clear English terms in their ordinary meanings, presents the necessary tool. The terms are **claims, grounds, warrants, backing, modal qualifiers,** and **possible rebuttals.**

In contrast, the terminology used in dealing with process, operative and procedural knowledge, metacognition, and formal operations tends to be specific to the context; thus faculty members find it difficult to communicate across departments, especially between those that are scientifically and humanistically oriented. The terminology in the Toulmin model, however, is generic. It eases communication because of the match between words used in the model and everyday language: claims, grounds, warrants, and backing. A series of key questions clarifies the use of the terms, as follows:

1. **Claims:** "What exactly are you claiming?"
2. **Grounds:** "What grounds is your claim based on?"
3. **Warrants:** ..."how do you justify the move from these grounds to that claim?"
4. **Backing:** ..."what other general information do you have to back up your trust in this particular warrant?"
5. **Modal Qualifiers:** "Just how reliably does this warrant lend weight to the given step from gounds to claim?"
6. **Possible Rebuttals:** "What possibilities might upset this argument?"

(See Toulmin, Rieke, & Janik, 1979, pp. 25-27.)

In practice, an individual makes a claim and seeks justifiable grounds to establish the truth of the claim. The linking of claim and grounds forms a warrant which can be judged by the strength of its backing. The expansion of these four terms permits mental movement into the use of process skills at an application level before contending with the precision of the terminology. Consequently, students are able to gain proficiency in the linguistic skills of reasoning and faculty members in the humanistic disciplines are able to encourage their students to reason without contending with the specific language of science.

Battaglini and Schenkat (Appendix C) related the process skills used in the Unified Science sequence to Toulmin's generic terms. All faculty and students at CST thus have a common vocabulary in which to discuss reasoning and critical thinking.

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* Taken from Toulmin, Rieke, & Janik. (1979). *An introduction to reasoning.* New York: Macmillan.

REFERENCES

Anderson, C.W., & Smith, E. L. New materials help overcome science misconceptions. *Communication Quarterly, 5,* 1983, 1-4.

Arons, A. B. Achieving wider scientific literacy. *Daedalus, 112,* 1983, 91-122.

Bateman, B. Personal communication to R. J. Schenkat, 1981.

Bateman, B. *Teaching reading to learning disabled children, a fourth approach.* University of Pittsburgh, April, 1976. (ERIC #155624).

Bateman, B. D. *The essentials of teaching.* San Rafael, CA: Dimension Publishing, 1971.

Battaglini, D., Horner, O., & Pirkl, M. *Unified science for preservice elementary school teachers. Teacher's Guide.* Winona, MN: College of Saint Teresa.

Behrens, T., & Grosenick, J. K. Deans' Grants projects. Supporting innovations in teacher-education programs. In J. K. Grosenick & M. C. Reynolds (Eds.). *Teacher Education. Renegotiating roles for mainstreaming.* Reston, Va: Council for Exceptional Children, 1978.

Blankenship, C.S., & Lilly, S. *Mainstreaming students with learning and behavior problems. Technics for the classroom teachers.* New York, Holt, Rinehart, & Winston, 1981.

Bloom, B. S. (Ed.). *Taxonomy of educational objectives,* Vol. 1. New York: David McKay, 1956.

Boorstin, D. J. *The Americans: The democratic experience.* New York. Random House, Vintage Books, 1974.

Bowen, C. D. *John Adams and the American Revolution.* New York. Grossett & Dunlap (paper-back), 1950.

Brown, A. L., Bransford, J. D., et al. *Learning, remembering, and understanding* (244). Center for the Study of Reading, University of Illinois at Urbana-Champaign, June 1982.

Brown, R. D. *Student development in tomorrow's higher education—a return to the academy.* Washington, D. C.: American College Personnel Association (Student Personnel Series No. 16), 1972.

Chickering, A. W. Introduction. In A. W. Chickering & Associates. *The modern American college.* San Francisco: Jossey-Bass, 1981.

Chickering, A. W., & Associates. *The modern American college.* San Francisco: Jossey-Bass, 1981.

Clark, C. M., & Yinger, R. J. *Research on teacher thinking.* Michigan State University. The institute for Research on Teaching, Research Series #12, 1978. (252 Erickson Hall, East Lansing, Michigan 48824.

College of Saint Teresa. *Design for Choicemakers.* Winona, MN: 1982.

College of Saint Teresa. *College of Saint Teresa: Design for Choicemakers. An operations manual for faculty and staff.* Winona, MN: June 1, 1983.

Connors, R An analysis of teacher thought processes, beliefs and principles during instruction. Unpublished doctoral dissertation, Department of Elementary Education, University of Alberta, 1978.

Cremin, L. B *The transformation of the school. Progressivism in American Education* 1876-1957. New York: Random House; Vintage Book (Paperback), 1964.

Durkin, Dolores. What classroom observations reveal about reading comprehension instruction. *Reading Research Quarterly,* Vol 14, 481-533, 1978-79.

Education Commission of the States. *The information society. Are high school graduates ready?* Denver, CO: Author. (Research Report) September 1982.

Gagne, R. M. *The condition of learning* (2nd ed.). New York: Holt, Rinehart & Winston, 1970.

Glaser, R. Psychology and instructional technology. In R. Glaser (Ed.), *Training, research and education.* New York: Wiley & Son, 1962.

Goodlad, J. I. What some schools and classrooms teach. *Educational Leadership,* 8-19, April 1983.

Goodlad, J. I. *What schools are for.* Phi Delta Kappa Educational Foundation, 1979.

Goodlad, J. I. *A place called school: Prospects for the future.* New York. McGraw-Hill, 1984.

Griffin, G. *The dilemma of determining essential planning and decision making skills for beginning educators.* Paper presented at the national meeting of the AACTE, Detroit, Michigan, February, 1983.

Haring, N. G (Ed.). *Behavior of exceptional children* (2nd ed.). Columbus, Ohio. Charles E. Merrill, 1978.

Harvey, O. J. Beliefs and behavior; some implications for education. *Science Teacher, 37,* 10-14, December, 1970.

Harvey, O. J., Hunt, D. E., & Schroder, H. M. *Conceptual systems and personality organization.* New York. Wiley, 1961.

Harvey, O. J., Prather, M., White, J. B., & Hoffmeister, J. K. Teachers' beliefs, classroom atmosphere, and student behavior. *American Educational Research Journal, 5*(2), 151-166, March 1968.

Hewson, M. G , & Hewson, P. W. Effect of instruction using students' prior knowledge and conceptual change strategies on science learning. *Journal of Research in Science Teaching, 20*(8), 731-743, 1983.
Hufker, Rosemary SCDES, As leaders in Faculty development. *Journal of Teacher Education,* Vol. 31, 16-20, February, 1980.
Hunter, M. *The science of the art of teaching. From controversy in education.* Philadelphia. W. B. Saunders, 1978.
Irmscher, W. F. Writing as a way of learning and developing. *College Composition and Communication, 30,* 240-244, October 1979.
Johnson, D W , & Johnson, R.T. *Promoting constructive student-student relationships through cooperative learning.* Washington, D.C.: American Association of Colleges for Teacher Education, 1980.
Jones, H. M. *A strange new world. American culture: The formative years.* New York: Viking (A Viking Compass Book), 1968.
Journal of Teacher Education, The liberal education of educators (Special Issue). May-June 1980.
Joyce, B R., Showers, B. *Power in staff development thru research on training.* Copyright by Association for Supervision and Curriculum Development, Alexandria, VA. 1983.
King, P. M. Perry's scheme and the Reflective Judgment Model. First cousins once removed. Paper presented at the annual conference of the Associaton for Moral Education, 1982.
Klemp, G O., Jr. Three factors of success. In D. W. Vermilye (Ed.), *Relating work and education.* San Francisco: Jossey-Bass, pp. 103-6, 1977.
Kluckhohn, C. *Mirror for man.* New York: Whittlesey House (McGraw-Hill), 1949.
Knapp, R Changing functions of the college professor. In N. Sanford (Ed.), *The American college: A psychological and social interpretation of the higher learning.* New York: John Wiley & Sons, pp. 290-311, 1962.
Lawson A E. et al. Proportional reasoning and linguistic abilities required for hypothetico-deductive reasoning. *Journal of Research in Science Teaching, 21*(4), 377-384, 1984.
Mitgang, L. Textbooks on trial: Texts blames for bored students! *La Crosse Tribune,* April 11, 1984. (An AP dispatch.)
Moore, W.E. *Creative and critical thinking.* Boston: Houghton-Mifflin, 1967.
Murphy, P. D., & Brown, M. M. Conceptual systems and teaching styles. *American Educational Research Journal, 7*(4), 529-540, November, 1970.
National Commission on Excellence in Education. *A nation at risk. The imperative for educational reform.* Washington, D.C.: U.S. Government Printing Office, Superintendent of Documents, 1983.
National Science Board, Commission on precollege education in mathematics, science and technology. The National Science Foundation, Washington, D.C. 1983.
National Science Board, Commission on precollege education in mathematics, science, and technology. *Educating Americans for the 21st century.* Washington, D.C.. National Science Board, National Science Foundation, 1983.
Newman, J. H., Cardinal. *The idea of a university.* Westminster, MD: Christian Classics, 1973.
Newsweek. Why public schools are flunking: Part one of a special report. pp. 62-73, April 20, 1981.
Orlett, J. OSF. The College of Saint Teresa Design for Choicemakers Program. Winona, MN. College of Saint Teresa. April, 1984. (Mimeo).
Osborne, R. J., & Wittrock, M. C. Learning science: A generative process. *Science Education, 67*(4), 489-508, 1983.
Parker, C. A. (Ed.). *Encouraging development in college students.* Minneapolis. University of Minnesota Press, 1978.
Parker, C. A. Teaching students to cope with complexity and uncertainty. *Lyceum, 3*(1), 1979-80.
Perry, W., Jr. *Intellectual and ethical development in the college years.* New York. Holt, Rinehart, & Winston, 1970.
Peters, T. J., & Waterman, Jr., R. H. *In search of excellence: Lessons from America's best run companies.* New York: Harper & Row, 1982.
Popham, W. J., & Baker, E. L. *Systematic instruction.* Englewood Cliffs, N. J.: Prentice-Hall, 1970.
Raths, L., Harmin, M., & Simon, S. *Values and teaching.* Columbus, OH: Charles Merrill, 1966.
Renner, J. W. The determination of intellectual levels of selected students. Final report to the National Science Foundation, P.O. Number 75-SP-0517, 1975.
Renner, J. W., & Lawson, A. E. Intellectual develpment in preservice elementary school teachers. An evaluation. *Journal of College Science Teaching, 2,* 1975.

Rowe M. B. *Teaching science as continuous inquiry: A basic.* New York: McGraw-Hill, 1978.
Sanford, N. Foreword. In A. W. Chickering & Associates. *The modern American college.* San Francisco: Jossey-Bass, 1981.
Sanford, N. (Ed.). *The American college: A psychological and social interpretation of the higher learning.* New York: John Wiley & Sons, 1962.
Sanford, N. Higher education as a field of study. In N. Sanford (Ed.), *American college.* New York. Wiley & Sons, pp. 31-73, 1962.
Sanford, N. *Where colleges fail: A study of the student as a person.* San Francisco: Jossey-Bass, 1967.
Sarason, S., & Doris, J. Mainstreaming: Dilemmas, opposition, opportunities. In M. C. Reynolds (Ed.). *Futures of education for exceptional students: Emerging structures.* Reston, VA: Council for Exceptional Children, 1978.
Schenck, S. J., & Levy, W. K. IEPs: *The state of the art in Connecticut.* Northeast Regional Resource Center, May 1979.
Schenkat, R. J. The place of teacher preparation in meeting the needs of all children in an austere decade. *National Apostolate with Mentally Retarded Persons* (NAMRP) *Quarterly,* summer, 1981.
Schroyer, J. Critical moments in the teaching of mathematics. What makes teaching difficult? Unpublished doctoral dissertation, College of Education, Michigan State University, 1981.
Shelly, A. C., & Schenkat, R. J. Revising the teacher education curriculum: Models of change. In AACTE, *Teacher preparation in small colleges. Regular educators and the education of handicapped children.* Washington, D.C.: (The American Association of Colleges for Teacher Education), 1983.
Smith, B. O. Pedagogical education: How about reform? *Phi Delta Kappan,* 1980, *2* 87-91.
Smith, E , & Anderson, C. Plants as producers: A case study of fifth-grade science teaching. Unpublished research report. College of Education, Michigan State University, 1982.
Stake, R E , & Easley, J Case studies in science education. *The case reports.* Washington, D.C.: Government Printing Office, 1978.
Taba, H. *Curriculum development, theory and practice.* New York: Harcourt, Brace, and World, 1962.
Toulmin, S., Rieke, R., & Janik, A. *An introduction to reasoning.* New York. Macmillan. (2nd ed., 1984), 1979.
Tyler, R. W *Basic principles of curriculum and instruction.* Chicago: University of Chicago Press, 1950.
Watson, G., & Glaser, E. *Critical thinking appraisal.* New York: Harcourt, Brace, Jovanovich, 1964.
Weintraub, F J., Abeson, A., Ballard, J., & LaVor, M. L. (Eds.). *Public Policy and the education of exceptional children.* Reston, VA: Council for Exceptional Children, 1976.
Welfel, E The development of reflective judgment: Its relationship to year in college, major field, academic performance, and satisfaction with major among college students. Unpublished doctoral dissertation, University of Minnesota, 1979.
Winston, R B., Miller, T., & Prince, J. S. *Assessing student development.* Student Development Associates, Athens, GA, 1979.
Woodlinger M. A study of teacher interaction decision making. Unpublished doctoral dissertation. Department of Education Administration, University of Alberta, 1980.